User Manual

Allen-Bradley

Kinetix 6000M Integrated Drive-Motor System

Catalog Numbers 2094-SEPM-B24-S, MDF-SB1003P, MDF-SB1153H, MDF-SB1304F

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Rockwell Automation

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Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting the Kinetix® 6000M Integrated Drive-Motor (IDM) system including the IDM Power Interface Module (IPIM).

For information on wiring and troubleshooting the safe-off feature on your integrated drive-motor system, refer to Appendix A.

This manual is intended for engineers or technicians directly involved in the installation, wiring, and programming of the Kinetix 6000M integrated drive-motor system.

If you do not have a basic understanding of the Kinetix drives, contact your local Rockwell Automation sales representative for information on available training courses.

Conventions Used in This Manual

The conventions listed below are used throughout this manual.

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Acronyms for the Kinetix 6000 and Kinetix 6200 system components and Kinetix 6000M integrated drive-motor are shown in the table below and are used throughout this manual.

Acronym	Kinetix Modules	Cat. No.
IDM	Integrated drive-motor	MDF-SB*xxxxx*-Q*x*8*x*A-S
IPIM	IDM power interface module	2094-SEPM-B24-S
IAM	Integrated axis module	2094-BC*xx*-M*xx-x*
AM	Axis module	2094-BM*xx-x*
LIM	Line interface module	2094-BL*xx* and 2094-BL*xx*S-*xx*

Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Kinetix 6000M IPIM-to-IDM Hybrid Cable Installation Instructions, publication 2090-IN031	Provides detailed cable information.
Kinetix 6000M IDM-to-IDM Hybrid Cable Installation Instructions, publication 2090-IN032	
Kinetix 6000M IDM Network Cable Installation Instructions, publication 2090-IN034	
Kinetix 6000M Manual Brake Release Cable Installation Instructions, publication 2090-IN037	

Resource	Description
Kinetix 6000M IPIM Hybrid Terminator Installation Instructions, publication 2090-IN035	Provides detailed terminator information.
Kinetix 6000M Network Terminator Installation Instructions, publication 2090-IN036	
Kinetix 6000M Hybrid Power Coupler Installation Instructions, publication 2090-IN038	Provides installation information for the Hybrid Power Coupler.
Kinetix 6000M Bulkhead Cable Adapter Kit Installation Instructions, publication 2090-IN039	Provides installation information for the Bulkhead Cable Adapter.
Kinetix 6000M Integrated Drive-Motor Installation Instructions, publication MDF-IN001	Provides installation information for the IDM unit.
Kinetix 6000M Integrated Drive-Motor Power Interface Module Installation Instructions, publication 2094-IN016	Provides information on the installation of the IPIM module.
Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001	Provides detailed information about the Kinetix 6000 drives.
Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002	Provides detailed information about the Kinetix 6200 drives.
Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010	Provides information on proper handling, installing, testing, and troubleshooting fiber-optic cables.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Provides information, examples, and techniques designed to minimize system malfunctions caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
Kinetix Rotary Motion Specifications, publication GMC-TD001	Provides IPIM module and IDM unit specifications.
Kinetix Motion Accessories Specifications, publication GMC-TD004	Provides product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items.
Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002	Provides information on wiring and troubleshooting your Kinetix 6000 servo drives with the safe-off feature.
Kinetix Motion Control Selection Guide, publication GMC-SG001	Provides specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products.
Sercos and Analog Motion Configuration User Manual, publication MOTION-UM001	Provides information on configuring and troubleshooting your ControlLogix®, CompactLogix™, and SoftLogix™ sercos interface modules.
Motion Coordinate System User Manual, publication MOTION-UM002	Provides information to create a motion coordinate system with sercos or analog motion modules.
SoftLogix Motion Card Setup and Configuration Manual, publication 1784-UM003	Provides information on configuring and troubleshooting SoftLogix PCI cards.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations.
Rockwell Automation Configuration and Selection Tools website: http://www.rockwellautomation.com/en/e-tools	Motion Analyzer application analysis software for drive/motor sizing. Online product selection and system configuration tools, including AutoCAD (DXF) drawings.
Rockwell Automation Product Certification website: http://www.rockwellautomation.com/products/certification	For declarations of conformity (DoC) currently available from Rockwell Automation.

You can view or download publications at http:/www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

Start

Use this chapter to become familiar with the design and installation requirements for the Kinetix 6000M integrated drive-motor system.

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About the Kinetix 6000M System

The Kinetix 6000M integrated drive-motor system is designed to provide a Kinetix Integrated Motion solution for your applications. Table 1 lists the components that can be used to build an integrated solution.

Table 1 - System Component Overview

System Component	Cat. No.	Description
IDM Unit	MDF-SB*xxxxx*-Q*x*8*x*A-S	Integrated drive-motor (IDM) unit with the safe-off feature. The unit contains a servo drive and motor.
IDM Power Interface Module (IPIM)	2094-SEPM-B24-S	460V AC integrated drive-motor power interface module that resides on the power rail and provides power and communications to the IDM units. The module also monitors power output and provides overload protection.
IDM Hybrid Cables	From the IPIM module to the first IDM unit: 2090-CHBIFS8-12AA*xx*	Hybrid cable provides power and inter-module communication to each IDM unit via daisy chain.
	From IDM unit to IDM unit: 2090-CHBP8S8-12AA*xx*	
IDM Network Cables	From the IPIM module to the first IDM unit: 2090-CNSSPRS-AA*xx*, 2090-CNSSPSS-AA*xx*	Required to daisy chain the Kinetix 6000M network.
	From IDM unit to IDM unit: 2090-CNSSPRS-AA*xx*, 2090-CNSSPSS-AA*xx*, 2090-CNSRPSS-AA*xx*, 2090-CNSRPRS-AA*xx*	
Integrated Axis Module	2094-BC*xx*-M*xx*-S (Kinetix 6000) 2094-BC*xx*-Mxx-M (Kinetix 6200)	460V Integrated Axis Modules (IAM) contains an inverter and converter section.
Axis Module	2094-BM*xx*-S (Kinetix 6000) 2094-BM*xx*-M (Kinetix 6200)	Axis Modules (AM) are a shared DC-bus inverter rated for 460V input power. The AM module must be used with an IAM module.
Shunt Module	2094-BSP2	The Bulletin 2094 shunt module mounts to the power rail and provides additional shunting capability in regenerative applications.

System Component	Cat. No.	Description
Power Rail	2094-PRSx	The Bulletin 2094 power rail consists of copper bus bars and a circuit board with connectors for each module. The power rail provides power and control signals from the converter section to adjacent inverters. The IPIM, IAM and AM power modules, shunt module, slot-filler modules mount to the power rail.
Power Rail Slot-filler Module	2094-PRF	The Bulletin 2094 slot-filler module is used when one or more slots on the power rail are empty after all the other power rail modules are installed. One slot-filler module is required for each empty slot.
Logix Controller Platform	1756-Mxx SE CompactLogix module 1768-M04SE ControlLogix module 1784-PM16SE PCI option card	The network interface module/PCI card serves as a link between the ControlLogix/CompactLogix/ SoftLogix platform and the Kinetix 6000 drive system. The communication link uses the IEC 61491 Serial Real-time Communication System (sercos) protocol over a fiber-optic cable.
RSLogix 5000 Software	9324-RLD300ENE	RSLogix 5000 software provides support for programming, commissioning, and maintaining the Logix family of controllers. Version 20 or later is required when using the Kinetix 6000M integrated drive-motor system.
Line Interface Modules	2094-BLxxS 2094-XL75S-Cx	Line interface modules (LIM) include the circuit breakers, AC line filter (catalog number 2094-BL02 only), power supplies, and safety contactor required for Kinetix 6000 operation. The LIM module does not mount to the power rail. You can purchase individual components separately in place of the LIM module.
IDM Unit Digital Input Cables	889D DC Micro	Allows use of sensors (see Digital Input Connectors on page 45). Also refer to the Connection Systems Quick Selection Guide, publication CNSYS-BR001, or the On-Machine™ Connectivity Catalog, publication M117-CA001.
Safe-Off Wiring Headers (1)	For first drive in multiple safety drive configurations: 2090-XNSM-W	Required for various installations of the IPIM module into the Kinetix 6000 servo drive systems.
	Middle header for drive-to-drive connections in multiple safety drive configurations with three or more drives: 2090-XNSM-M	
	Safe-off terminating header for the last drive in multiple safety drive configurations: 2090-XNSM-T	
Sercos Interface Cables	Network fiber-optic plastic cables, regular duty: 2090-SCEP*x-x* 2090-SCVP*x-x* 2090-SCNP*x-x* (harsh duty) Network fiber-optic glass cables: 2090-SCVG*x-x* Network fiber optic cable bulkhead adapter: 2090-S-BLHD (2 per pack)	Required for various installations of the IPIM module into the Kinetix 6000 and Kinetix 6200 servo drive systems.
EtherNet/IP Interface Cables	RJ45-to-RJ45: 1585J-M8CBJM-*xx*: RJ45 Insulation Displacement Connector: 1585J-M8CC-H Cable, shielded: 1585-C8CB-S*xxx*	Required for various installations of the IPIM module into the Kinetix 6200 servo drive systems.
Cascaded Safety Cables	1202-C*xx* (*xx* = length)	Required accessory to support cascaded safety wiring across multiple modules on the 2094 power rail.
Bulkhead Adapter Kits	Network cable: 2090-CBUSPSS	Provides wall-mount connectors for hybrid and network cables. The connector kit allows signals to pass through a cabinet wall or other physical barrier.
	Hybrid cable: 2090-KPB47-12CF	

(1) Refer to Appendix A for safety information.

Typical Hardware Configurations

SHOCK HAZARD: To avoid personal injury due to electrical shock, place a 2094-PRF slot-filler module in all empty slots on the power rail.
Any power rail connector without a module installed will disable the 3-phase power; however, control power is still present.

Figure 1 - Typical Kinetix 6000M Integrated Drive-motor System

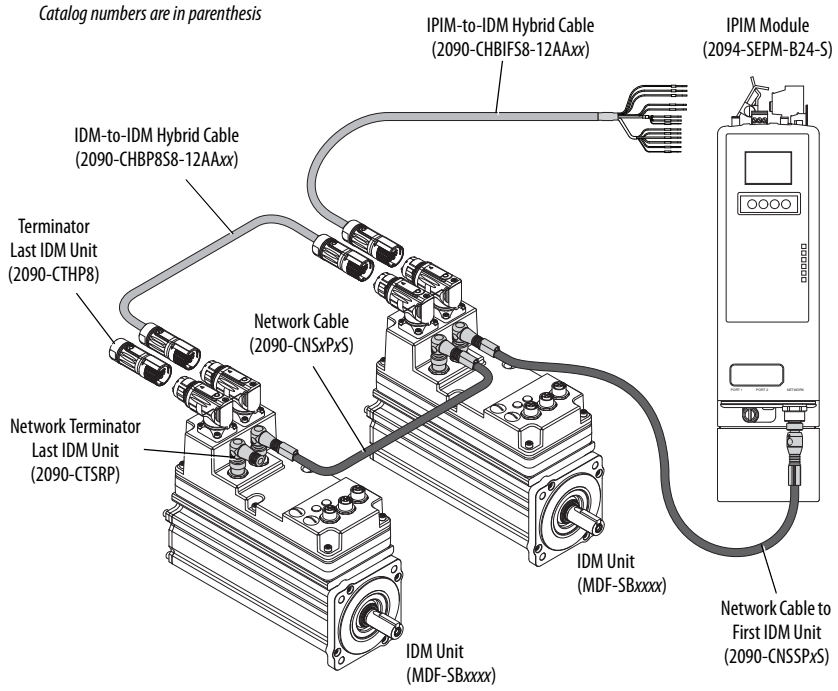

Catalog numbers are in parenthesis
IPIM-to-IDM Hybrid Cable (2090-CHBIFS8-12AAxx)
IPIM Module (2094-SEPM-B24-S)
IDM-to-IDM Hybrid Cable (2090-CHBP8S8-12AAxx)
Terminator Last IDM Unit (2090-CTHP8)
Network Cable (2090-CNSxPxS)
Network Terminator Last IDM Unit (2090-CTSRP)
IDM Unit (MDF-SBxxxx)
IDM Unit (MDF-SBxxxx)
Network Cable to First IDM Unit (2090-CNSSPxS)

Figure 2 - Typical 2094 Power Rail with Kinetix 6000M System (with LIM)

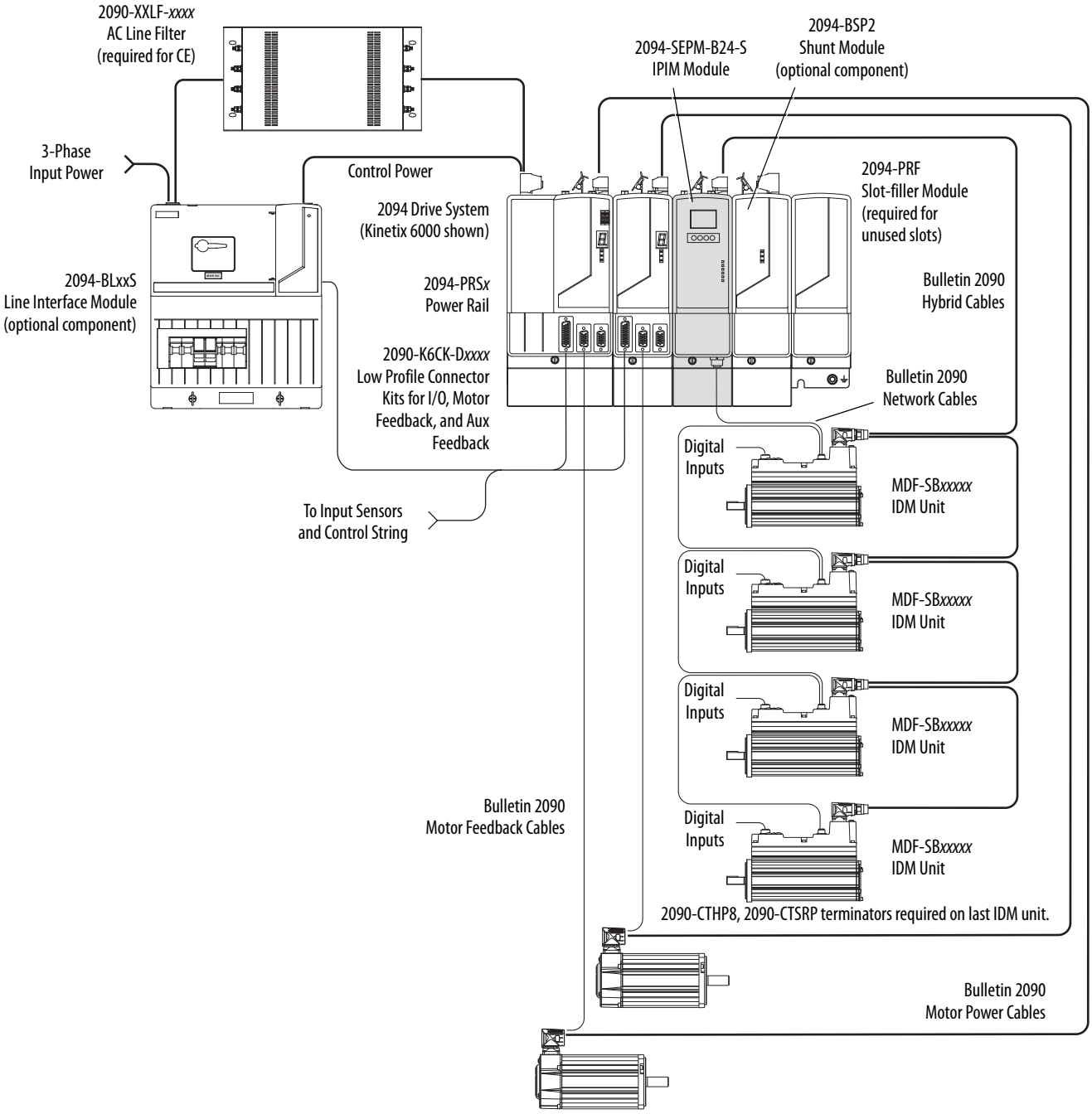
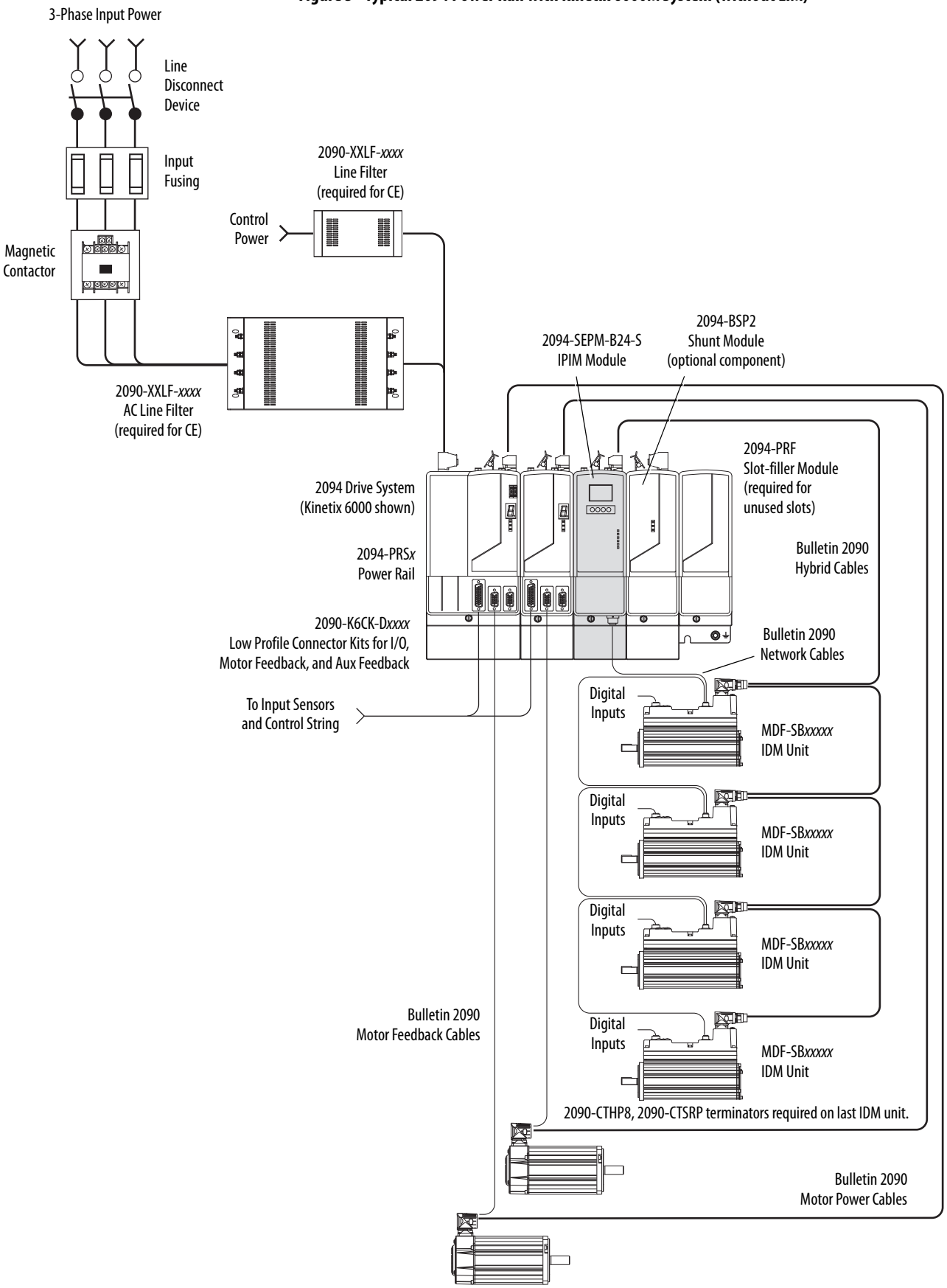


Figure 3 - Typical 2094 Power Rail with Kinetix 6000M System (without LIM)


3-Phase Input Power
Line Disconnect Device
Input Fusing
Magnetic Contactor
2090-XXLF-xxxx Line Filter (required for CE)
Control Power
2090-XXLF-xxxx AC Line Filter (required for CE)
2094-SEPM-B24-S IPIM Module
2094-BSP2 Shunt Module (optional component)
2094-PRF Slot-filler Module (required for unused slots)
2094 Drive System (Kinetix 6000 shown)
2094-PRSx Power Rail
Bulletin 2090 Hybrid Cables
2090-K6CK-Dxxxx Low Profile Connector Kits for I/O, Motor Feedback, and Aux Feedback
Bulletin 2090 Network Cables
To Input Sensors and Control String
Digital Inputs
MDF-SBxxxxx IDM Unit
Digital Inputs
MDF-SBxxxxx IDM Unit
Digital Inputs
MDF-SBxxxxx IDM Unit
Digital Inputs
MDF-SBxxxxx IDM Unit
Bulletin 2090 Motor Feedback Cables
2090-CTHP8, 2090-CTSRP terminators required on last IDM unit.
Bulletin 2090 Motor Power Cables

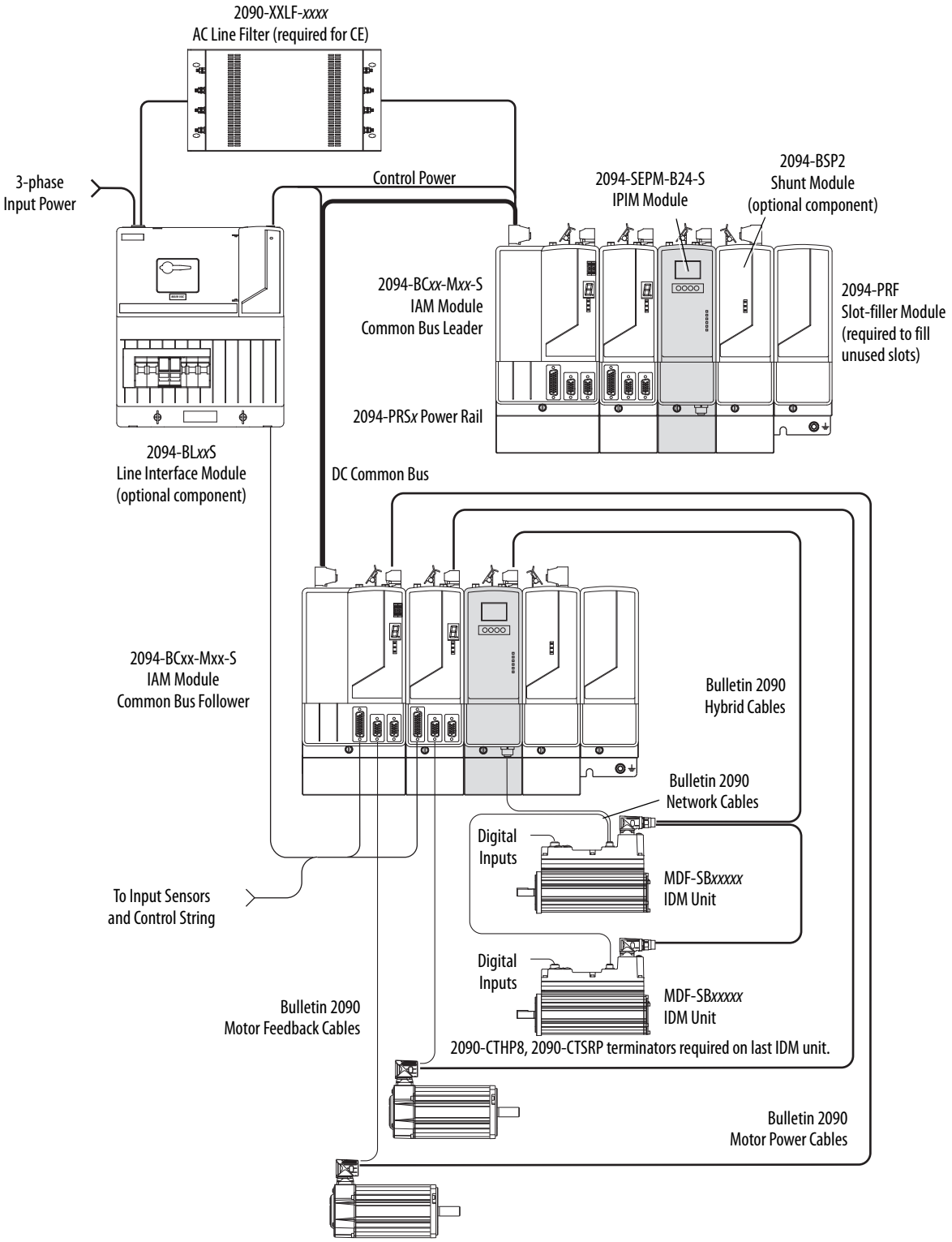
In the following example, the leader IAM module is connected to the follower IAM module via the DC common-bus. When planning your panel layout, you must calculate the total bus capacitance of your DC common-bus system to be sure that the leader IAM module is sized sufficiently to pre-charge the entire system.

Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, for further information.

IMPORTANT If total bus capacitance of your system exceeds the leader IAM module pre-charge rating and input power is applied, the IAM module status indicator will display an error code.

To correct this condition, you must replace the leader IAM module with a larger module or decrease the total bus capacitance by removing AM or IPIM modules.

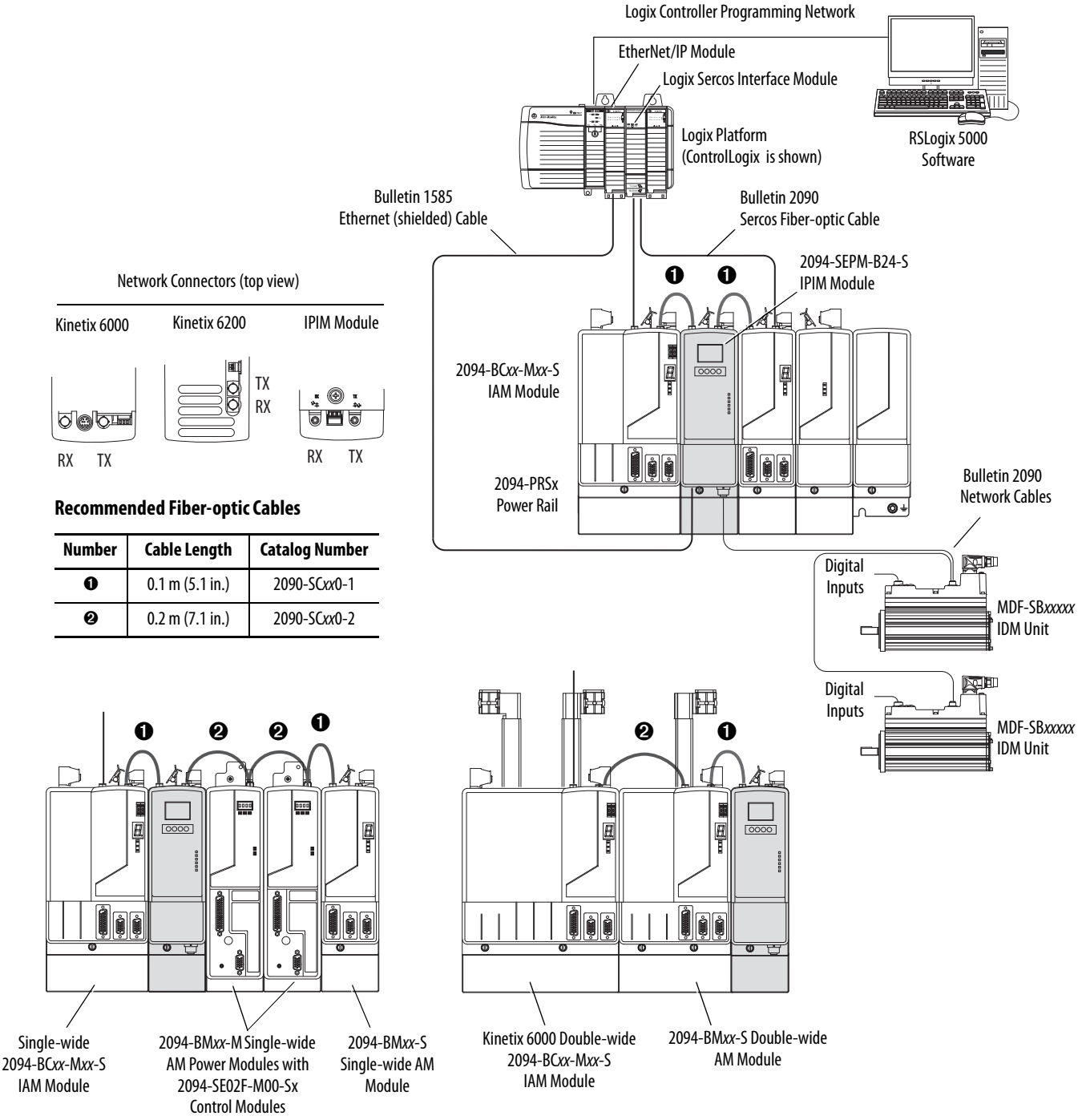
Figure 4 - Typical Kinetix 6000 with Kinetix 6000M System Common Bus



Typical Communication Configurations

The Kinetix 6000M IPIM module uses the EtherNet/IP network to report diagnostics to the controller and for firmware upgrades via ControlFLASH™ software. For more information on Ethernet cables, refer to the Industrial Ethernet Media Brochure, publication 1585-BR001.

Figure 5 - Typical Kinetix 6000M, Kinetix 6000 and Kinetix 6200 Network Configuration



Recommended Fiber-optic Cables

Number	Cable Length	Catalog Number
❶	0.1 m (5.1 in.)	2090-SCxx0-1
❷	0.2 m (7.1 in.)	2090-SCxx0-2

Catalog Number Explanations

Kinetix 6000M catalog numbers and descriptions are listed in the tables below.

Table 2 - Power Interface Module (IPIM)

Cat. No.	Description
2094-SEPM-B24-S	460V IDM Power Interface Module (IPIM) w/Safe-off

Table 3 - Integrated Drive-motor (IDM)

Cat. No. (No Brake)	Cat. No. (with Brake)	Description
MDF-SB1003P-QJ82A-S	MDF-SB1003P-QJ84A-S	460V, IEC 100 mm, 5000 rpm, Keyed
MDF-SB1003P-QK82A-S	MDF-SB1003P-QK84A-S	460V, IEC 100 mm, 5000 rpm, Smooth
MDF-SB1153H-QJ82A-S	MDF-SB1153H-QJ84A-S	460V, IEC 115 mm, 3500 rpm, Keyed
MDF-SB1153H-QK82A-S	MDF-SB1153H-QK84A-S	460V, IEC 115 mm, 3500 rpm, Smooth
MDF-SB1304F-QJ82A-S	MDF-SB1304F-QJ84A-S	460V, IEC 130 mm, 3000 rpm, Keyed
MDF-SB1304F-QK82A-S	MDF-SB1304F-QK84A-S	460V, IEC 130 mm, 3000 rpm, Smooth

Table 4 - Replacement Parts

Cat. No.	Description
MPF-SST-A3B3 MPF-SST-A4B4 MPF-SST-A45B45	Shaft seal kit for: MDF-SB1003 MDF-SB1153 MDF-SB1304
2094-XNIPIM	IPIM module connectors; includes hybrid DC bus, hybrid communication, safe-off, and enable.
2094-SEPM-FUSE	Fuses for IPIM module, 6 each.
MDF-SB-NODECVR	IDM unit node address switch covers.
1485-M12	IDM unit digital input connector covers.
2090-CTHP8 2090-CTSRP	Terminator: Hybrid Network

Table 5 - Accessories

Cat. No.	Description
MPS-AIR-PURGE	Positive air pressure kit.

Component Compatibility

The Kinetix 6000M integrated drive-motor system is compatible with:

- 400V-class Series B Kinetix 6000 drive systems
- 400V-class Kinetix 6200 drive systems

IMPORTANT Kinetix 6500 EtherNet/IP control modules (catalog numbers 2094-EN02D-M01-Sx) are not compatible with the Kinetix 6000M IPIM or Kinetix 6000/ Kinetix 6200 IAM and AM modules on the same Bulletin 2094 power rail.

IMPORTANT The IDM system cannot be accessed with DriveExplorer™ or a human interface module (HIM). However, all IDM units will respond to a Stop command from a HIM.

Table 6 - IDM System Compatibility

Component	Requires
RSLinx® software version	RSLinx version 2.59 or greater will fully support the IPIM module after installation of an appropriate EDS file
RSLogix™ 5000 software	20.01 (1) or later
IPIM AOP (Add-On Profile)	1.x
Kinetix 6000 drive firmware	1.123 or later
Kinetix 6200 drive firmware	1.045 or later
ControlLogix EtherNet/IP modules	All 1756 Ethernet modules; 1756-ENBT, 1756-EN2T

(1) Version 20.00 may be used if the motion database is updated to version 8.12. For detailed information about updating the motion database, refer to RA Knowledgebase article 490160.

Agency Compliance

If this product is installed within the European Union and has the CE mark, the following regulations apply.

ATTENTION: Meeting CE requires a grounded system, and the method of grounding the AC line filter and IDM must match. Failure to do this renders the filter ineffective and may cause damage to the filter.
Refer to Grounding the IDM System on page 54.

For more information on electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

CE Requirements (system without LIM module)

To meet CE requirements when your system does not include the LIM module, these requirements apply:

- Install an AC line filter (catalog number 2090-XXLF-*xxxx*) as close to the IAM module as possible.
- Use line filters for 3-phase input power and single-phase control power.
- Use 2090 series cables.
- Use 889 series sensor cables.
- Combined motor power cable length for all axes on the same power rail must not exceed 240 m (787 ft).
- Combined cable length for all IDM units connected to a single IPIM module is 100 m (328 ft).
- Install the Kinetix 6x00 system inside an enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.

Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, for interconnect diagrams, including input power wiring.

CE Requirements (system with LIM module)

To meet CE requirements when your system includes the LIM module, follow all the requirements as stated in CE Requirements (system without LIM module) and these additional requirements as they apply to the AC line filter.

- Install the LIM module (catalog numbers 2094-BL02) as close to the IAM module as possible.
- Install the LIM module (catalog numbers 2094-BL*xx*S, or 2094-XL75S-C*x*) with line filter (catalog number 2090-XXLF-*xxxx*) as close to the IAM module as possible.

  When the LIM module (catalog numbers 2094-BL*xx*S, or 2094-XL75S-C*x*) supports two IAM modules, each IAM module requires an AC line filter installed as close to the IAM module as possible.

Notes:

Planning the Kinetix 6000M System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 6000M components.

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ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

Cable Length Restrictions and System Sizing

This section provides guidelines for sizing an IDM system. For accurate, detailed sizing, use Motion Analyzer software version 6.000 or later. For additional information and a sizing estimation method, refer to Kinetix 6000M System Sizing on page 127.

When sizing your system, please note the following:

- Motion Analyzer software (version 6.000 or later), should be used for sizing your system.
- Maximum cable length between IDM units is 25 m (82 ft).
- Combined cable length for all IDM units connected to a single IPIM module is 100 m (328 ft).
- Combined motor power and hybrid cable length for all axes on the same power rail must not exceed 240 m (787 ft).
- The number of IDM units also depends on the use of the safe-off function. Refer to Using the Safe Torque-off Feature with the Kinetix 6000M System on page 103 for details.

The following items limit the number of IDM units that can be used in a system.

1. The IDM unit control power load which consists of three load sources:
   - internal load (constant)
   - parking brake load
   - digital input loading.

   These items also affect the total control power load:
   - The cable lengths between IDM units
   - IDM units with brakes and their location in the daisy chain
   - IDM units that use digital inputs.
2. The continuous and intermittent load on the DC bus of all AM modules and IDM units.

IMPORTANT The Kinetix 6000 or Kinetix 6200 IAM module supplying DC bus power to the IDM units should be sized to support all IDM units connected to the power rail. Motion Analyzer software (version 6.000 or later) sizing analysis accounts for control power and DC bus power.

3. The total number of axes connected in the safe-off circuit.

IPIM Module Design Guidelines

Use the information in this section when designing your enclosure and planning to mount your system components.

For on-line product selection and system configuration tools, including AutoCAD (DXF) drawings of the product, refer to http://www.rockwellautomation.com/en/e-tools.

System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 6000M power interface module must be part of a Kinetix 6000 or Kinetix 6200 system that is enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP2X such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- Size the enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all components.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

- Combined motor power cable lengths for all axes and hybrid cable lengths for all IDM units on the same DC bus must not exceed 240 m (787 ft) with 400V-class systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

IMPORTANT	System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, to better understand the concept of electrical noise reduction.

Circuit Breaker/Fuse Options

The 2094-SEPM-B24-S IPIM module and the MDF-SBxxxxx IDM units use internal solid-state motor short-circuit protection and when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 200,000 A. Fuses or circuit breakers, with adequate withstand and interrupt ratings, as defined in NEC or applicable local codes, are permitted.

The 2094-BL02 LIM module contains supplementary protection devices and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 5000 A. When these modules are used, protection on the line side of the LIM module is required. Fuses must be class J or CC only.

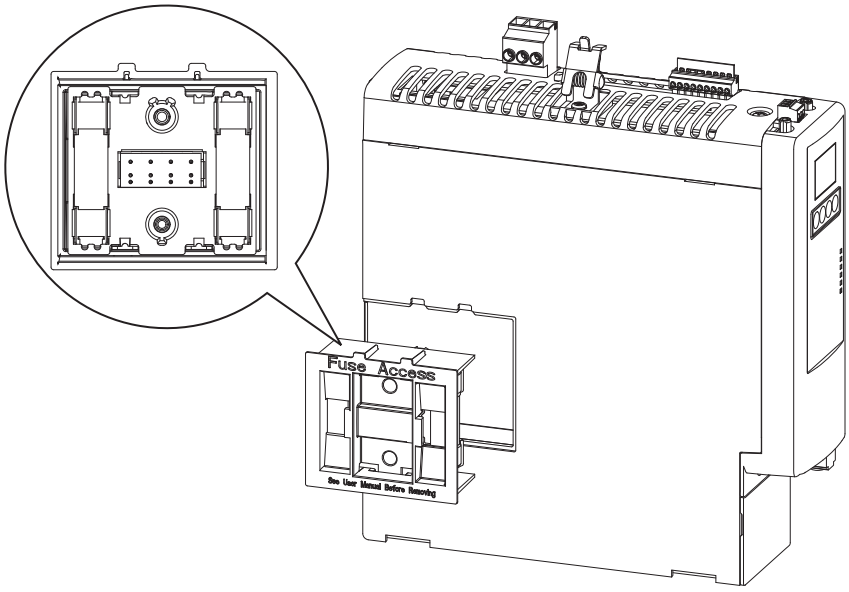
The 2094-BL*xx*S, and 2094-XL75S-C*x* LIM modules contain branch circuit rated devices suitable for use on a circuit capable of delivering up to 65,000 A (400V-class).

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, for power specifications and more information on using the LIM module.

Fuse Location and Replacement

The IPIM module uses internal fuses (see Figure 6) for short-circuit protection of the DC bus. The recommended fuse is Bussmann FWP-50A14Fa. A fuse replacement kit (catalog number 2094-SEPM-FUSE) is also available.

Figure 6 - IPIM Fuse Location



ATTENTION: Capacitors on the DC bus may retain hazardous voltages after input power has been removed. Before working on the IDM system, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the IPIM module. Failure to observe this precaution could result in severe bodily injury or loss of life.

To replace the fuses, follow these steps.

1. Ensure that all power to the power rail has been removed.
2. Measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the IPIM module.
3. Loosen the captive screws.
4. Grasp the top and bottom edges of the fuse holder and pull straight out.
5. Replace the fuses.

Enclosure Selection

Heat dissipation of the IPIM module is shown in Table 7 and Table 8. To size the enclosure you will need heat dissipation data from all equipment inside the enclosure (such as the Logix controller, LIM module, IAM). Once the total amount of heat dissipation (in watts) is known, you can calculate the minimum enclosure size.

Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, for further information.

Table 7 - Power Dissipation Specifications - Percent of DC Bus Current

Power Dissipation as % of DC Bus Current Output Rating Watts					
20%	**40%**	**60%**	**80%**	**100%**	**Heat Dissipation Formula (1)**
2	7	14	25	38	$Y = 33.95x^2 + 3.18x$

(1) *x* is percent of DC bus current output rating: any value between 0.0 and 1.0.

Table 8 - Power Dissipation Specifications - Percent of IPIM Module Control Power

Control Power Input		Power Dissipation as % of IPIM Module Control Power Output Rating Watts					
Frequency Hz	**Voltage** AC	**20%**	**40%**	**60%**	**80%**	**100%**	**Heat Dissipation Formulas (1)**
50	120V	22	29	38	48	61	$Y = 23.76x^2 + 20.73x + 16.54$
	240V	34	42	52	63	76	$Y = 18.56x^2 + 30.19x + 27.41$
60	120V	23	27	32	39	46	$Y = 14.57x^2 + 11.40x + 20.01$
	240V	38	49	62	76	92	$Y = 19.63x^2 + 43.22x + 28.75$

(1) *x* is percent of IPIM module control power output rating: any value between 0.0 and 1.0.

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your IDM unit.

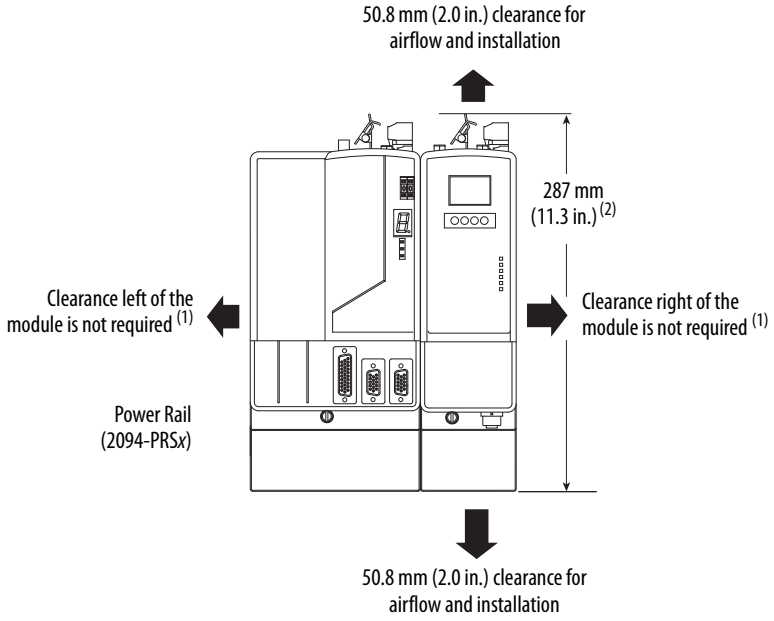
Figure 7 illustrates minimum clearance requirements for proper airflow and installation:

- Additional clearance is required for the cables and wires connected to the top and front of the module.
- Additional clearance left and right of the power rail is required when the module is mounted adjacent to noise sensitive equipment or clean wireways.

Table 9 - Minimum Cabinet Depth

Cat. No.	Cabinet Depth, Min
2094-SEPM-B24-S	272 mm (10.7 in.)

Figure 7 - Minimum IPIM Module Clearance Requirements


50.8 mm (2.0 in.) clearance for airflow and installation
287 mm (11.3 in.) (2)
Clearance left of the module is not required (1)
Clearance right of the module is not required (1)
Power Rail (2094-PRSx)
50.8 mm (2.0 in.) clearance for airflow and installation

(1) The power rail (slim), catalog number 2094-PRSx, extends left and right of the first and last module 5.0 mm (0.20 in.). The Bulletin 2094-PRx power rail extends approximately 25.4 mm (1.0 in.) left of the IAM module and right of the last module mounted on the rail.

(2) Dimension applies to the following modules:

IPIM module	2094-SEPM-B24-S
IAM module (Series B)	2094-BC01-M*xx*-*x* and 2094-BC02-M02-x
AM module (Series B)	2094-BMP5-*x*, 2094-BM01-*x*, 2094-BM02-*x*

IDM Unit Design Guidelines

Minimum Clearance Requirements

Figure 8 illustrates minimum IDM unit clearance requirements for proper airflow and installation.

BURN HAZARD: Outer surfaces of the motor can reach high temperatures, 125 °C (275 °F), during motor operation.

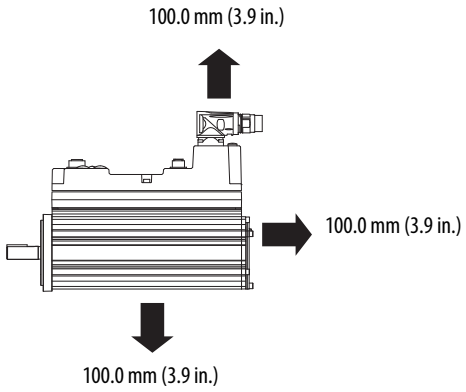
Take precautions to prevent accidental contact with hot surfaces. Consider IDM unit surface temperature when selecting motor mating connections and cables.

Failure to observe these safety procedures could result in personal injury or damage to equipment.

Additionally, consider the following items:

- Obtain the specified motor thermal rating by mounting the motor on a surface with heat dissipation equivalent to a 304.8 x 304.8 x 12.7 mm (12 x 12 x 0.5 in.) aluminum heatsink.
- Do not install the motor in an area with restricted airflow, and keep other heat producing devices away from the motor.

Figure 8 - Minimum IDM Unit Clearance Requirements



Electrical Noise Reduction

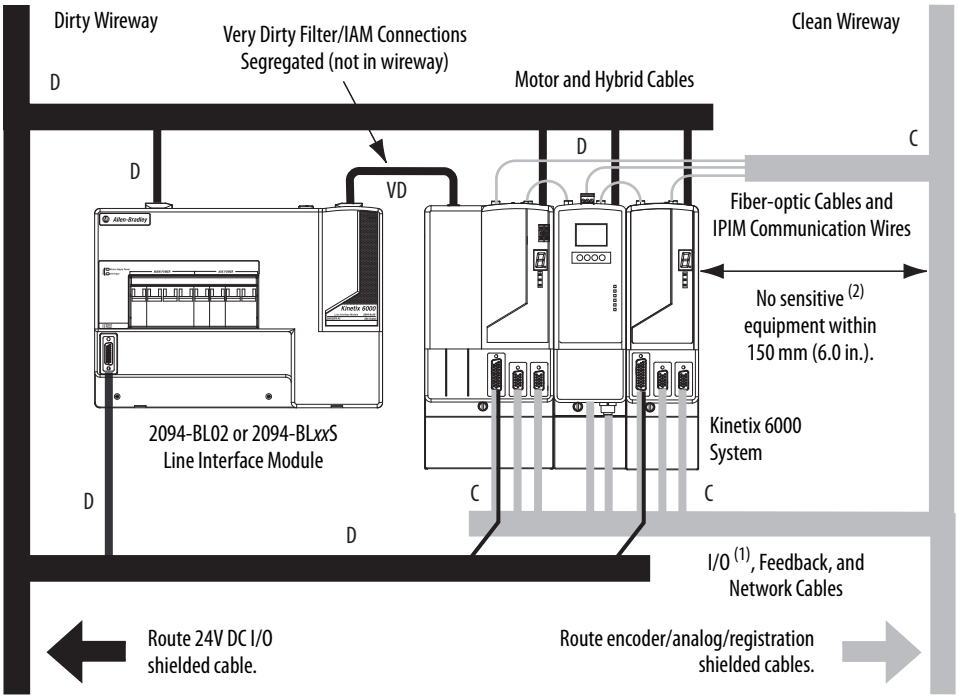
Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, for information on best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 6000 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe these guidelines when your system includes the 2094-SEPM-B24-S IPIM module. In this example, a 2094-BL02 LIM module is used in the Bulletin 2094 system and mounted left of the IAM module:

- Establish clean (C) and dirty zones (D) similar to other Bulletin 2094 drive systems.
- The sercos fiber-optic cables are immune to electrical noise, but due to their delicate nature, route them in the clean zone.
- IPIM communication wires are noise sensitive and belong with the fiber-optic cables in the clean zone.
- Ethernet cables are noise sensitive and belong in the clean zone.
- IDM network cables, although noise sensitive by nature, are shielded and designed to be routed with the hybrid cable outside of the enclosure.
- The Bulletin 2090 hybrid cable is dirty and belongs in the dirty zone.

This layout is preferred due to the reduced size of the very dirty zone.

Figure 9 - Noise Zones (Bulletin 2094 power rail with IPIM module)



(1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module I/O cable in dirty wireway.
(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Cable Categories for Kinetix 6000M System

Zoning requirements of cables connecting to the IDM system components are shown in Table 10.

Table 10 - IPIM Module Zoning Requirements

Wire/Cable	Zone			Method	
	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
Hybrid DC bus power, control power, inter-module communication, and safe-off (1)		X			X
		X			X
		X			
Enable input			X		X
Fiber-optic	No restrictions				
Ethernet network			X		X
IDM network (1)			X		X

(1) There is no option for making your own hybrid or IDM network cables.

Mounting the Kinetix 6000M System

This chapter provides the system installation procedures for mounting your Kinetix 6000M integrated drive-motor (IDM) unit and your power interface module (IPIM).

Topic	Page
Mounting the IPIM Module	30
Installing the IDM Unit	33

This procedure assumes you have prepared your panel, mounted your Bulletin 2094 power rail, and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2094 power rail and modules prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

Mounting the IPIM Module

Using the 2094 Mounting Brackets

You can use Bulletin 2094 mounting brackets to mount the power rail or LIM module over the AC line filter. Refer to the 2094 Mounting Brackets Installation Instructions, publication 2094-IN008, when using mounting brackets with your system.

Installing the 2094 Power Rail

The Bulletin 2094 power rail comes in lengths to support one IAM module and up to seven additional modules. A maximum of four IPIM modules can be mounted to a single power rail. The connector pins for each slot are covered by a protective cover. The cover is designed to protect the pins from damage and make sure that no foreign objects lodge between the pins during installation. Refer to the Kinetix 6000 Power Rail Installation Instructions, publication 2094-IN003, when installing your power rail.

ATTENTION: To avoid damage to the power rail during installation, do not remove the protective covers until the module for each slot is ready for mounting.

Determine Mounting Order

Refer to the Module Mounting Order Example diagram on page 31 and mount the modules in the order (left to right) shown. Install modules according to power utilization (highest to lowest) from left to right starting with the highest power utilization. If power utilization is unknown, position modules (highest to lowest) from left to right based on the IPIM or AM continuous power rating (kW).

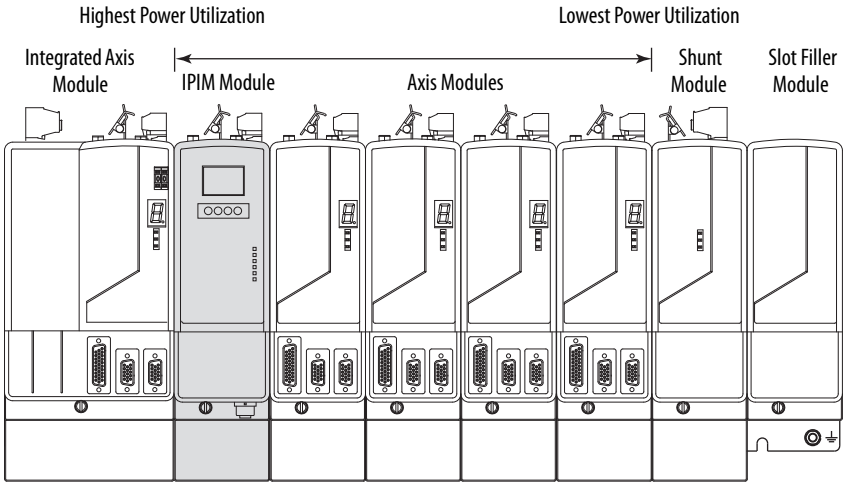
Power utilization is the average power (kW) consumed by a servo axis. If the servo axis has been sized by using Motion Analyzer software, version 6.000 or later, the calculated axis power required can be used for power utilization. If the servo axis has not been sized in Motion Analyzer, use Table 11, showing the maximum continuous power for IPIM and AM modules, to determine the desired location on a power rail.

Table 11 - Module Type and Continuous Power Output

2094-BM05-S Axis Module	2094-SEPM-B24-S IPIM Module	2094-BM03-S Axis Module	2094-BM02-S Axis Module	2094-BM01-S Axis Module	2094-BMP5-S Axis Module
22.0 kW	15.0 kW	13.5 kW	6.6 kW	3.9 kW	1.8 kW

The IPIM module may be installed on a power rail with an IAM module configured as a common bus follower, but you will be responsible for configuring the leader for the appropriate additional capacitance in the follower power rail, including the IPIM module.

Figure 10 - Module Mounting Order Example



IMPORTANT The IAM must be positioned in the leftmost slot of the power rail. Position your other modules to the right of the IAM module.

Mount modules according to power utilization (highest to lowest) from left to right starting with the highest power utilization. If power utilization is unknown, position modules (highest to lowest) from left to right based on continuous power rating (kW). Refer to page 30.

The shunt module must be installed to the right of the last module. Only slot-filler modules may be installed to the right of the shunt module.

Do not mount the shunt module on power rails with a follower IAM module. Common bus follower IAM modules disable the internal, rail mounted, and external shunt modules.

SHOCK HAZARD: To avoid personal injury due to electrical shock, place a 2094-PRF slot-filler module in all empty slots on the power rail. Any power rail connector without a module installed will disable the drive system; however, control power will still be present.

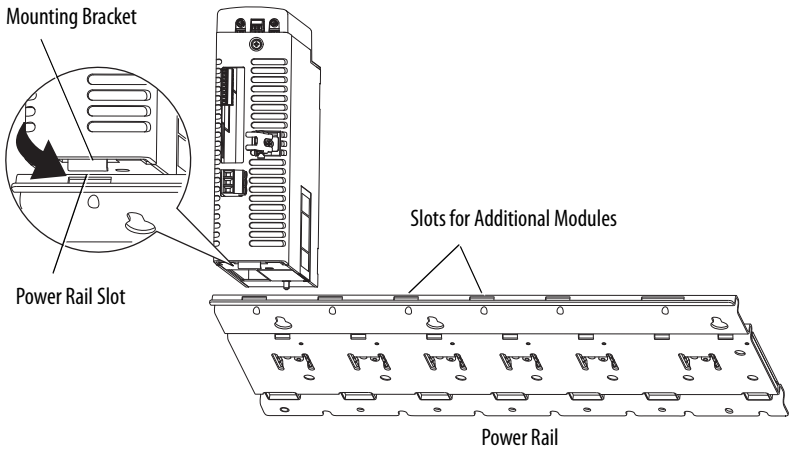
Mount the IPIM Module

All modules mount to the power rail using the same technique.

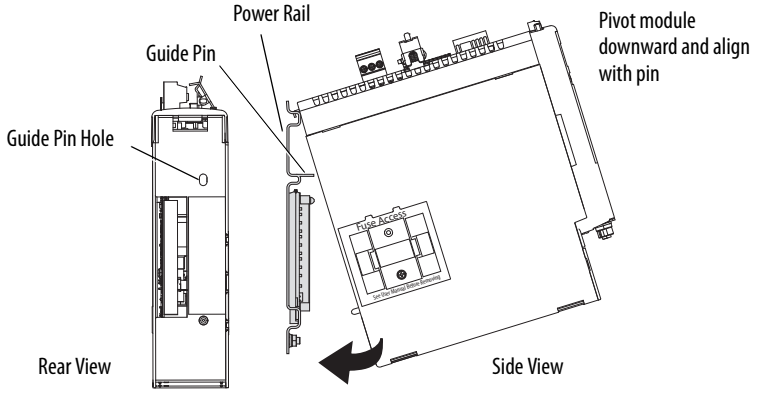
1. Determine the next available slot and module for mounting. Refer to Determine Mounting Order on page 30.
2. Remove the protective covers from the power rail connectors.
3. Inspect the module connector pins and power rail connectors and remove any foreign objects.

> **ATTENTION:** To avoid damage to the pins located on the back of each module and to make sure that module pins mate properly with the power rail, hang modules as explained below.
>
> The power rail must be mounted vertically on the panel before hanging modules on the power rail.

4. Hang the module mounting bracket from the slot on the power rail.

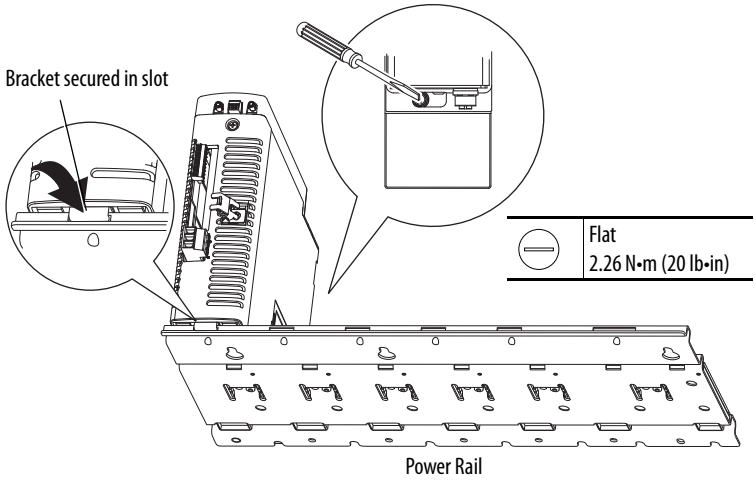


5. Pivot module downward and align the guide pin on the power rail with the guide pin hole in the back of the module.



6. Gently push the module against the power rail connectors and into the final mounting position.

7. Tighten the mounting screws.



8. Repeat the above steps for each module being installed.

Installing the IDM Unit

ATTENTION: Do not attempt to open or modify the IDM unit. This manual describes modifications that you can perform in the field. Do not attempt other changes. Only a qualified Allen-Bradley employee can service an IDM unit.

Failure to observe these safety procedures could result in personal injury or damage to equipment.

ATTENTION: Damage may occur to the bearings and the feedback device if a sharp impact is applied to the shaft during installation of couplings and pulleys, or to remove the shaft key. Damage to the feedback device also may result from applying leverage from the faceplate to remove devices mounted on the shaft.

Do not strike the shaft, key, couplings, or pulleys with tools during installation or removal. Use a wheel puller to apply pressure from the user end of the shaft to remove any friction fit or stuck device from the shaft.

Failure to observe these safety procedures could result in damage to the IDM unit.

Aligning the IDM Unit

The IDM unit can be mounted in any position and has a mounting pilot that aids in aligning the unit on a machine. A shaft seal that helps protect the motor against fine dust and fluids is factory installed and should be replaced at regular intervals.

Preferred fasteners are stainless steel. The installation must comply with all local regulations. The installer also must use equipment and installation practices that promote electromagnetic compatibility and safety.

ATTENTION: Unmounted IDM units, disconnected mechanical couplings, loose shaft keys, and disconnected cables are dangerous, if power is applied.

Disassembled equipment should be appropriately identified (tagged-out) and access to electrical power restricted (locked-out).

Before applying power, remove the shaft key and other mechanical couplings that could be thrown from the shaft.

Failure to observe these safety procedures could result in personal injury or damage to equipment.

Mount and Connect the IDM Unit

To install the IDM unit, follow these procedures and recommendations.

ATTENTION: Arcing or unexpected motion can occur if cables are connected or disconnected while power is applied to the IDM system. Before working on the system, disconnect power and wait the full time interval indicated on the IPIM module warning label or verify the DC bus voltage at the IPIM module measures less than 50V DC.

Failure to observe this precaution could result in severe bodily injury or loss of life, and damage to the product will occur.

ATTENTION: Do not strike the shaft, couplings, or pulleys with tools during installation or removal.

Damage may occur to the motor bearings and the feedback device if you apply a sharp impact to the shaft during installation of couplings and pulleys, or a shaft key.

Failure to observe these safety procedures could result in damage to the motor and its components.

ATTENTION: The IDM unit is not for direct connection to an AC power line.

IDM units are designed for connection to an IPIM module that controls the application of power.

Failure to observe these safety precautions could result in damage to the motor and equipment.

1. Allow sufficient clearances around the IDM unit for it to stay within its specified operating temperature range. See page 27 for details.

BURN HAZARD: Outer surfaces of the IDM unit can reach high temperatures, 125 °C (275 °F), during motor operation.

Take precautions to prevent accidental contact with hot surfaces. Consider IDM unit surface temperature when selecting motor mating connections and cables.

Failure to observe these safety procedures could result in personal injury or damage to equipment.

2. Determine the radial and axial shaft load limitations of your motor. Refer to the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001, for specifications.
3. Set the node address for the IDM unit. Refer to Setting the Node Address on page 70.
4. If sufficient mounting clearance is provided, rotate the hybrid cable connectors into position prior to installing. If the mounting clearance is restricted, rotate after installing.

ATTENTION: Connectors are designed to be rotated into a fixed position during motor installation, and remain in that position without further adjustment. Strictly limit the applied forces and the number of times the connector is rotated to make sure that connectors meet the specified IP ratings.

Apply force only to the connector and cable plug. Do not apply force to the cable extending from the cable plug. No tools, for example pliers or vise-grips, should be used to assist with the rotation of the connector.

Failure to observe safety precautions could result in damage to the IDM unit and its components.

5. Position the IDM unit on the machine in any position.

TIP IDM units with a brake may require use of the manual brake release cable to release the brake prior to rotating the shaft so the IDM unit will align with the machine mounts.

Refer to the Manual Brake Release Cable Installation Instructions, publication 2090-IN037, for details on using this cable.

6. Properly mount and align the IDM unit using stainless steel bolts. Refer to the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001, for dimensions.

Notes:

Kinetix 6000M System Connector Data

This chapter provides connector locations and signal descriptions for your Kinetix 6000M integrated drive-motor system.

Topic	Page
IPIM Module Connectors and Indicators	38
IPIM Module Connector and Signal Descriptions	39
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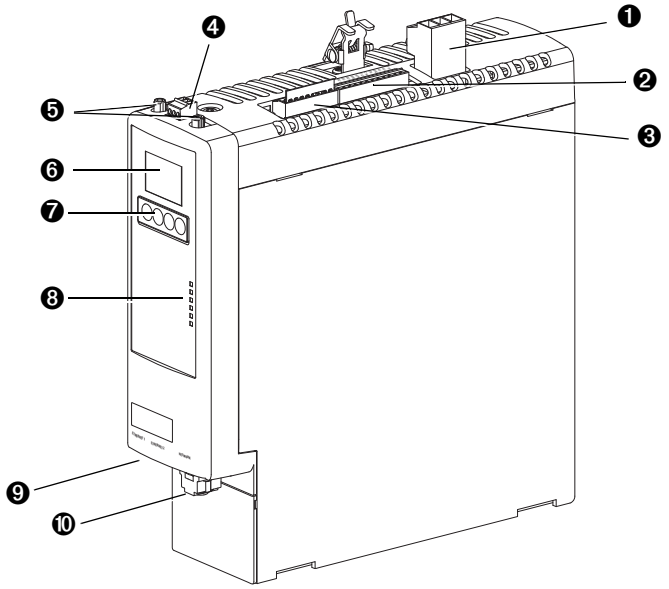
IDM Unit Connector and Signal Descriptions	44
Power Specifications	50
Feedback Specifications	52

IPIM Module Connectors and Indicators

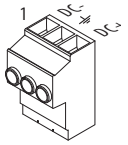
Figure 11 - Module Connectors and Indicators



Item	Description		See page
❶	Hybrid cable DC bus connector	Termination point for +/- DC and PE	39
❷	Hybrid cable communication signals connector	Connection point for IDM unit power and communication	39
❸	Safe-off connector	Termination point for safety signals	40
❹	Enable connector	Enable input to the IDM system	41
❺	Sercos fiber-optic connectors	Transmit and receive fiber-optic connectors	41
❻	LCD display	Allows ethernet configuration and system status	66
❼	Navigation buttons	Four buttons provide access and navigation when using the LCD display	66
❽	Status indicators DC Bus Control Bus Port 1 and Port 2 Module Status Network Status	 DC bus status Control bus status (present, faulted) Communication status of the EtherNet/IP ports IPIM module status (operating, standby, faulted) Indicates IDM system network status	90
❾	EtherNet/IP ports	Two Ethernet ports are provided	42
❿	IDM network cable connector	Connection point for network cable to first IDM unit	42

IPIM Module Connector and Signal Descriptions

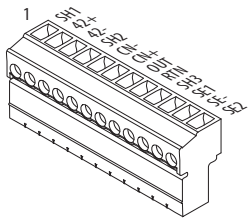
Hybrid Cable DC Bus Connector



This connector supplies the DC bus voltage. Three wires from the hybrid power and communication cable (catalog number 2090-CHBIFS8-12AA*xx*) are used to extend this voltage to the first IDM unit.

Terminal	Description	Signal		Strip Length mm (in.)	Torque N•m (lb•in)
1	DC bus supply (-)	DC-	DC-	9.7 (0.38)	0.75 (6.6)
2	Chassis ground	⏚	⏚		
3	DC bus supply (+)	DC+	DC+		

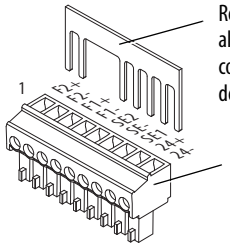
Hybrid Cable Communication Signals Connector



The hybrid communication connector extends control power, communication, and safety signals to the first IDM unit. The 2090-CHBIFS8-12AA*xx* cable interfaces with this connector.

Terminal	Description	Signal		Strip Length mm (in.)	Torque N•m (lb•in)
1	Shield	–	SH1	6.4 (0.25)	0.235 (2.0)
2	Control Power +42V DC	42V +	42+		
3	Control Power -42V DC	42V COM	42-		
4	CAN Bus Shield	IDM CAN SHIELD	SH2		
5	IDM CAN Bus Lo	IDM CAN LO	CN-		
6	IDM CAN Bus Hi	IDM CAN HI	CN+		
7	System OK out to IDMs	IDM SYSOKOUT	OUT		
8	System OK return from IDMs	IDM SYSOKRTN	RTN		
9	Safety Shield	SAFETY SHIELD	SH3		
10	Safety Enable Input 1	SAFETY ENABLE 1+	SE1		
11	Safety Enable Common	SAFETY ENABLE-	SE-		
12	Safety Enable Input 2	SAFETY ENABLE 2+	SE2		

Safe Torque-off Connector



This connector provides a termination point for connecting safety devices such as: emergency stop switches, light curtains, and floor mats. The redundant safety device outputs should be connected to Safety Enable Input 1 and 2 with reference to Safety Enable Common.

Each IPIM module ships with the wiring-plug header and motion-allowed jumper installed in the safe torque-off connector.

IMPORTANT With the motion-allowed jumper installed, the safe torque-off function is defeated.

IMPORTANT Pins 8 and 9 (24V+) are used only by the motion-allowed jumper. When wiring to the wiring-plug header, **the 24V supply** (for an external safety device that triggers the safe torque-off request) **must come from an external source**, otherwise system performance will be jeopardized.

This connector extends the safe-off signals for use in wiring single and multiple safe torque-off configurations, or to bypass (not use) the safe torque-off function. Refer to page 107 for further information.

Terminal	Description	Signal		Strip Length mm (in.)	Torque N•m (lb•in)	Min/Max Wire Size (3) mm² (AWG)
1	Feedback Monitoring 2+	FDBK2+ (1)	F2+	7.0 (0.275)	0.235 (2.0)	0.14…1.5 (30…14)
2	Feedback Monitoring 2-	FDBK2- (1)	F2-			
3	Feedback Monitoring 1+	FDBK1+ (1)	F1+			
4	Feedback Monitoring 1-	FDBK1- (1)	F1-			
5	Safety Enable Input 2	SAFETY ENABLE 2+	SE2			
6	Safety Enable Common	SAFETY ENABLE-	SE-			
7	Safety Enable Input 1	SAFETY ENABLE 1+	SE1			
8	Safety Bypass Supply, +24V DC, 320 mA max	24+ (2)	24+			
9	Safety Bypass supply, Common	24V COM (2)	24-			

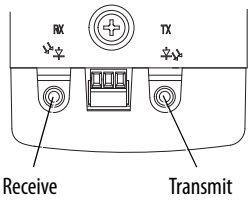
(1) Feedback monitoring terminals are provided for compatibility with the Kinetix 6000 safety connector only.

(2) Refer to page 107 for information on the proper use of these terminals.

(3) Maximum/minimum that the connector will accept—these are not recommendations.

Sercos Fiber-optic Connectors

The sercos fiber-optic ring is connected by using the sercos receive (RX) and transmit (TX) connectors.



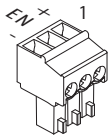
ATTENTION: To avoid damage to the sercos RX and TX connectors use only finger-tight torque when attaching the fiber-optic cables. Do not use a wrench or any other mechanical assistance. For more information, refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010.

Table 12 - Sercos Specifications

Attribute	Value
Data rates	8 Mbps (fixed)
Light intensity	Adjustable, low or high power, selectable via the keypad/LCD display (see page 68).
Cyclic update period	500 µs, minimum
Node addresses	Assigned on each IDM unit, see page 70. The IPIM module does not have a sercos address since it is not a sercos device.

Enable Input

One digital input is supplied to enable all connected IDM units. The enable status is transmitted to all of the IDM units.



Terminal	Description	Signal		Strip Length mm (in.)	Torque N•m (lb•in)	Min/Max Wire Size (1) mm² (AWG)
1	+24V DC Enable Supply	ENABLE 24V+	+	7.0 (0.275)	0.235 (2.0)	0.14…1.5 (30…14)
2	Enable Input	ENABLE INPUT	EN			
3	24V DC Common	ENABLE 24V COM	-			

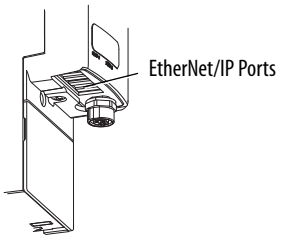
(1) Maximum/minimum that the connector will accept—these are not recommendations.

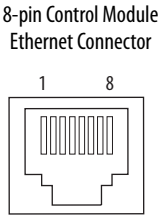
Table 13 - Enable Input Specifications

Signal	Description	IDM Unit Reaction Time	Edge/Level Sensitive
ENABLE	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V DC input is applied to this terminal to enable all modules. The reaction time for all IDM units connected to the IPIM is 30 ms, maximum.	30 ms	Level

EtherNet/IP Connectors

Two connectors are provided for firmware upgrades, troubleshooting, and integration with Logix. The Ethernet ports also support a web browser interface to provide access to status information for the IPIM module and IDM units.

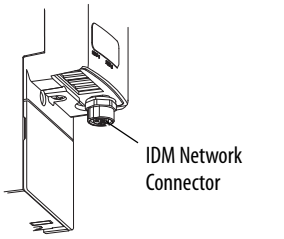


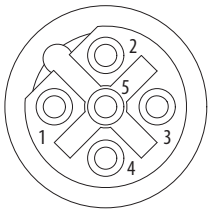


Pin	Signal Description	Signal Name
1	Transmit+	TD+
2	Transmit-	TD-
3	Receive+	RD+
4	Reserved	–
5	Reserved	–
6	Receive-	RD-
7	Reserved	–
8	Reserved	–

IPIM Module Network Connector Pinouts

The IDM system network is routed by using 2090-CNS*x*P*x*S-AA*xx* cables. A 2090-CNSSPRS-AA*xx* or 2090-CNSSPSS-AA*xx* cable is required for connection to the IPIM module. The connector type is B-coded M12.

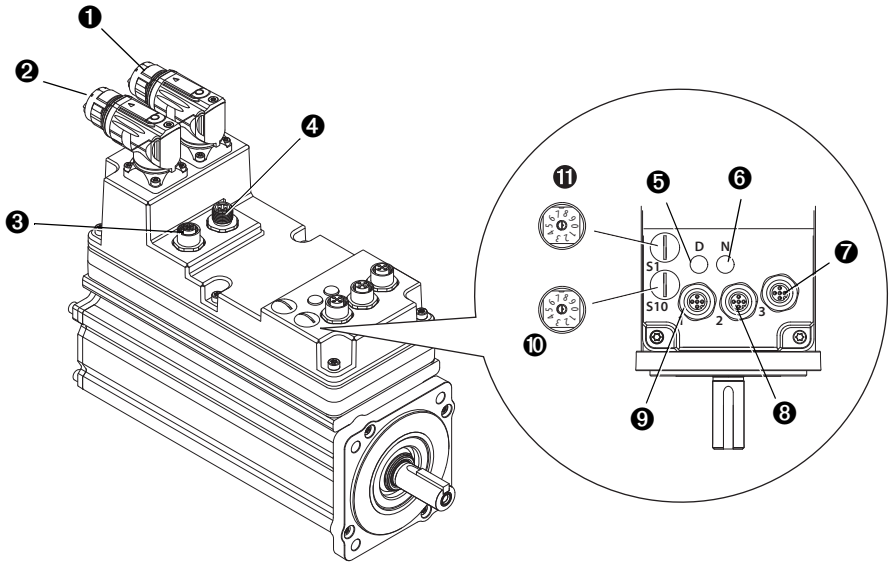




Pin	Signal Description	Signal Name
1	Transmit (TX+) to IDM unit	TX+
2	Return (RX-) from IDM unit	RTN RX-
3	Return (RX+) from IDM unit	RTN RX+
4	Transmit (TX-) to IDM unit	TX-
5	Reference signal	REF

IDM Unit Connectors and Indicators

Figure 12 - Integrated Drive-motor Unit Features, Connectors, and Indicators

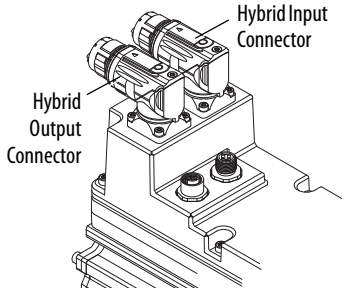


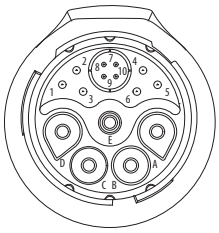
Item	Description		See page
❶	Hybrid cable input connector (from IPIM module or previous IDM unit)	Input and output connecting points for the Hybrid Power and Communication cables.	39
❷	Hybrid cable output connector (to IDM unit)		
❸	IDM network output connector (to IDM unit)	Input and output connecting points for the IDM network cables.	39
❹	IDM network input connector (from IPIM module or previous IDM unit)		
❺	Drive status indicator	Provides communication status for the IDM unit.	91
❻	Network status indicator	Provides general status for the IDM unit.	91
❼	HOME Digital Input (connector 3)	Digital input for home.	45
❽	REG1/OT+ Digital Input (connector 2)	Registration1/positive overtravel digital input.	45
❾	REG2/OT- Digital Input (connector 1)	Registration2/negative overtravel digital input.	45
❿	Node address switch S10 – 10's digit (most significant)	Sets the IDM network node address.	70
⓫	Node address switch S1 – 1's digit (least significant)		

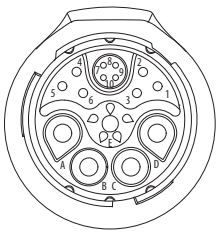
IDM Unit Connector and Signal Descriptions

Hybrid Cable Connector

The information below provides connector pinouts for the IDM unit hybrid connectors.



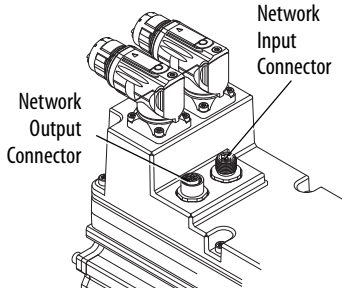


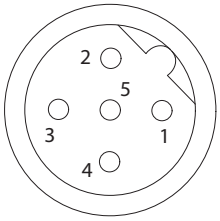
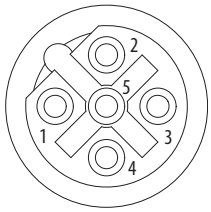


Pin	Description	Input Connector Signal Name	Output Connector Signal Name
A	DC Bus +	DC +	DC +
B	DC Bus -	DC -	DC -
C	Control Power +42V DC	42V +	42V +
D	Control Power -42V DC	42V COM	42V COM
E	Chassis Ground	⏚	⏚
1	Reserved	Reserved	Reserved
2	Brake Override 24V Supply	BRAKE +24V	
3	Brake Override Supply Common	BRAKE 24V COM	
4	Safety Enable Input 1	SAFETY ENABLE 1+	SAFETY ENABLE 1+
5	Safety Enable Common	SAFETY ENABLE-	SAFETY ENABLE-
6	Safety Enable Input 2	SAFETY ENABLE 2+	SAFETY ENABLE 2+
7	IDM CAN Bus Hi	IDM CAN HI	IDM CAN HI
8	IDM CAN Bus Lo	IDM CAN LO	IDM CAN LO
9	System OK from IPIM or prior IDM	IDM SYSOKIN	IDM SYSOKOUT
10	System OK return to IPIM	IDM SYSOKRTN	IDM SYSOKRTN

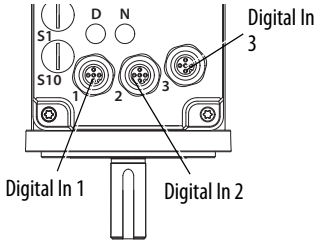
IDM Network Input and Output Connector Pinouts

Pinout information is provided below for the IDM unit network connectors.



	Input Connector	Output Connector
		
Pin	**Signal Name**	**Signal Name**
1	RX+	TX+
2	RTN TX-	RTN RX+
3	RTN TX+	RTN RX-
4	RX-	TX-
5	REF	REF

Digital Input Connectors



Three digital input connectors allow sensors to be easily connected to the system without the need to route cables back to the control enclosure.

The connectors accommodate common input functions, including the following:

- Home, negative over-travel and positive over-travel inputs
- Two registration inputs

If the digital inputs are not being used for their assigned functions, they can also be used as general purpose inputs by reading the status of the their tags in the application program.

24V DC is supplied at each input for the purpose of registration, home, enable, over-travel positive, and over-travel negative inputs. These are sinking inputs that require a sourcing device. A 24V DC power and common connection is provided for each input. A total of 200 mA is supplied for all three input connectors.

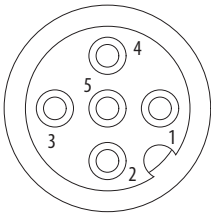
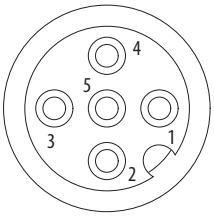
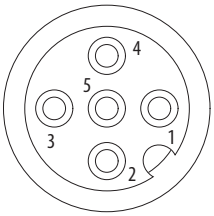
IDM units have three 5-pin, M12, digital input connectors. Allen-Bradley (Bulletin 889D) DC micro-style patchcords, splitters, and V-cables are available with straight and right-angle connectors for making connections from the IDM unit to input sensors.

For the most popular patchcord specifications, refer to the Connection Systems Quick Selection Guide, publication CNSYS-BR001. For complete information, refer to On-Machine™ Connectivity, publication M117-CA001.

IMPORTANT Unused input connectors must have protective covers installed to maintain the IDM IP rating. Torque each cover to 0.6 N•m (5 lb•in) to ensure a tight seal.

IMPORTANT To improve registration input EMC performance, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

IMPORTANT Overtravel limit input devices must be normally closed.

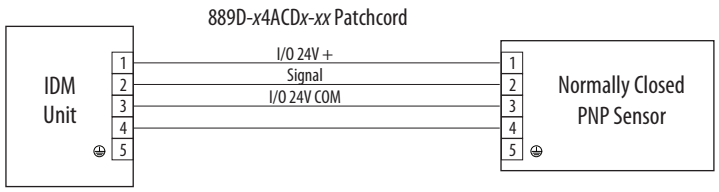
	Digital Input Connector 1 Overtravel -/Registration 2	**Digital Input Connector 2 Overtravel +/Registration 1**	**Digital Input Connector 3 Home**
			
Pin	**Signal Name**	**Signal Name**	**Signal Name**
1	24V +	24V+	24V+
2	Overtravel -	Overtravel +	Reserved
3	24V COM	24V COM	24V COM
4	Registration 2	Registration 1	HOME
5	Shield/Chassis Ground	Shield/Chassis Ground	Shield/Chassis Ground

The IDM unit only supports PNP (active high or sourcing) inputs.

Single Normally Closed (NC) Sensor Connection

Normally closed sensors are used for limit (overtravel) switches on the IDM unit. Any 4-pin or 5-pin, M12, A-code, 1-1 pass through cable can be used to connect a normally closed sensor. Refer to Figure 13.

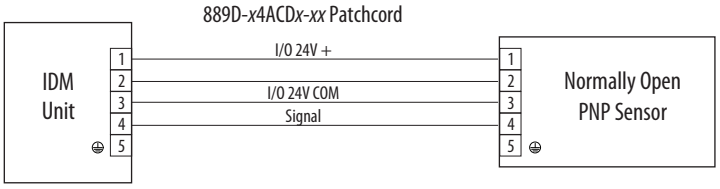
Figure 13 - Single NC Sensor Connection Example



Single Normally Open (NO) Sensor Connection

Normally open sensors are used for registration or home switches on the IDM unit. Any 4-pin or 5-pin, M12, A-code, 1-1 pass through cable can be used to connect a normally open sensor. Refer to Figure 14.

Figure 14 - Single NO Sensor Connection Example

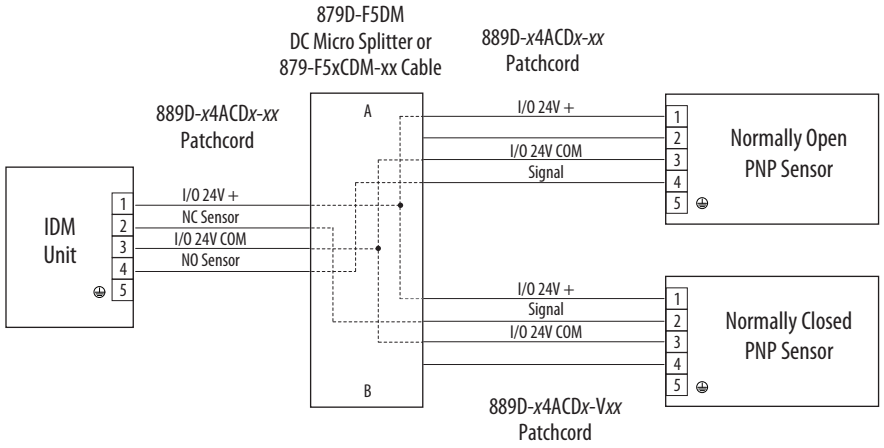


Combined NC & NO Sensor Connection

There may be applications where two sensors must be connected to a one input connector. Typically, a limit switch (NC) is connected to pin 2 and a registration switch (NO) to pin 4 of the connector.

In the figure below the 889D-*x*4ACD*x-xx* patchcord swaps the NC signal from pin 2 to pin 4. The micro splitter then swaps it back for proper connection to pin 2 of the IDM input connector. The NO sensor goes straight through on pin 4.

Figure 15 - Combined NO & NC Sensor Connection using a Micro Splitter



Digital Input Cable Examples

Figure 16 - Digital Inputs Used for Home and Overtravel Functions

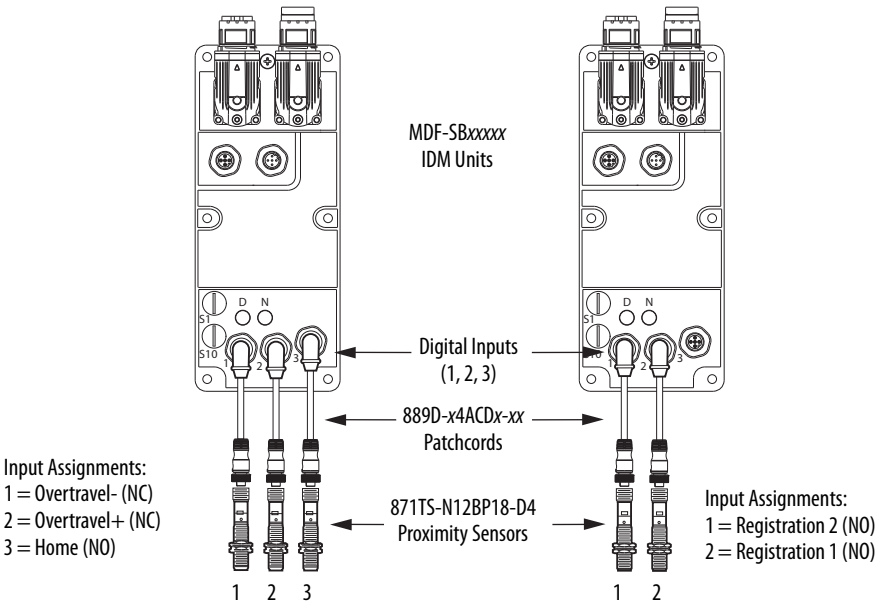


Figure 17 - Digital Inputs Used for Home, Overtravel, and Registration Functions

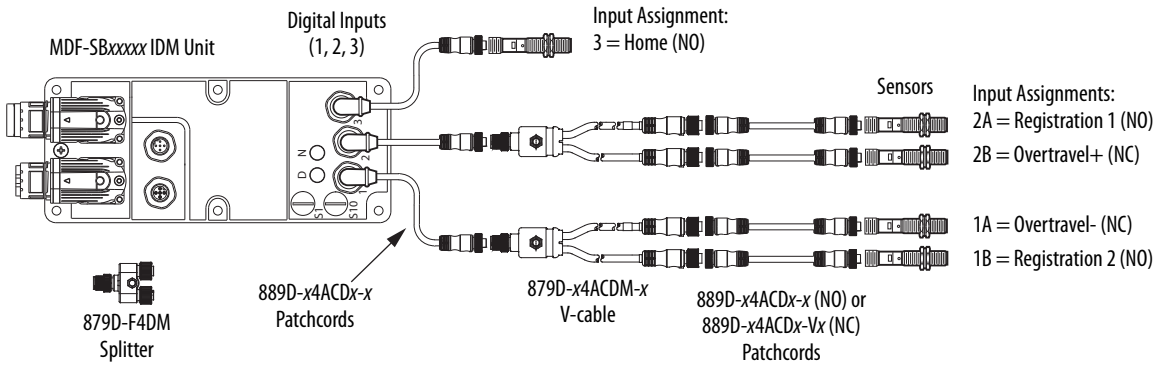


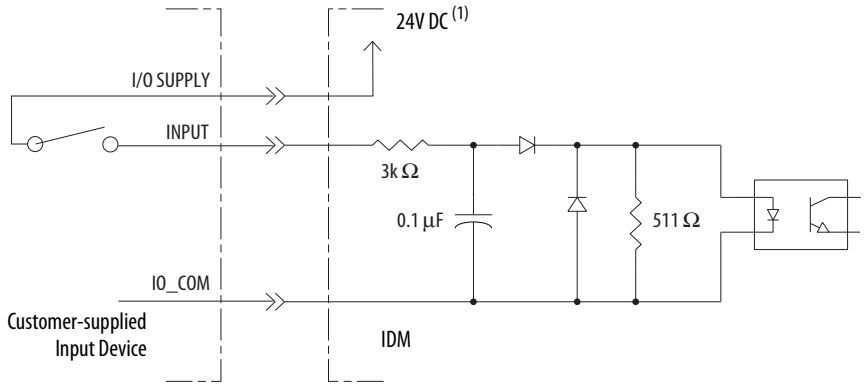
Table 14 - Understanding the Digital Inputs

Pin	Connector	Signal	Description	Capture Time	Edge/Level Sensitive
4	1	HOME	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. Home switch (normally open contact) inputs for each axis require 24V DC (nominal).	30 ms	Level
4	2/3	REG1 REG2	Fast registration inputs are required to inform the motor interface to capture the positional information with less than 4 μs uncertainty. Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V DC input is applied to this terminal.	500 ns	Edge
2	2/3	OT+ OT-	Overtravel detection is available as an optically isolated, single-ended active high signal. Current loading is nominally 10 mA per input. The pos/neg limit switch (normally closed contact) inputs for each axis require 24V DC (nominal).	30 ms	Level

Table 15 - Digital Input Specifications

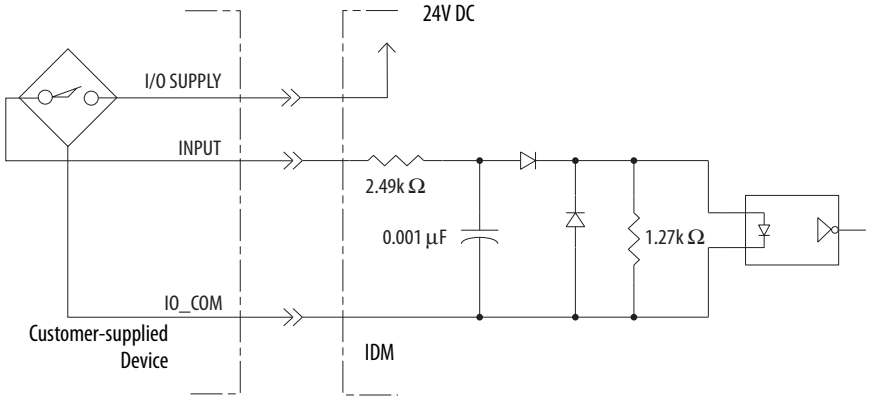
Parameter	Description		Min	Max
On-state voltage	Voltage applied to the input, with respect to IOCOM, to assure an on-state.	HOME, and OT+/OT-	21.6V	26.4V
		REG1 and REG2	21.6V	26.4V
On-state current	Current flow to guarantee an on-state.		3.0 mA	10.0 mA
Off-state voltage	Voltage applied to the input, with respect to IOCOM, to assure an off-state.		-1.0V	3.0V

Figure 18 - Standard Digital Input Circuits



(1) 24V DC source (range) = 21.6V - 26.4V (supplied by IPIM, not to exceed 250 mA total). Maximum current input = 10 mA.

Figure 19 - High Speed Digital Input Circuits



Power Specifications

Brake Override Input

ATTENTION: To guard against personal injury and/or component damage, the brake override must only be used for machine assembly when the IPIM module **is not** connected to the IDM unit.

The brake override connection is made on two dedicated pins of the hybrid input connector. The hybrid cable has no connection on those pins.

The brake override may only be activated when the hybrid input cable is not connected. A brake override cable is attached at the location where the hybrid input cable would normally be attached.

Two connections are required for the motor/brake override input power. Connections are rated for +24V and current as shown in the table below. An active signal releases the motor brake.

Table 16 - Brake Specification

Specification	Value
Nominal brake voltage	24 V DC
Minimum voltage	21.6 V DC
Maximum voltage	27.6 V DC
Maximum brake current	650 mA

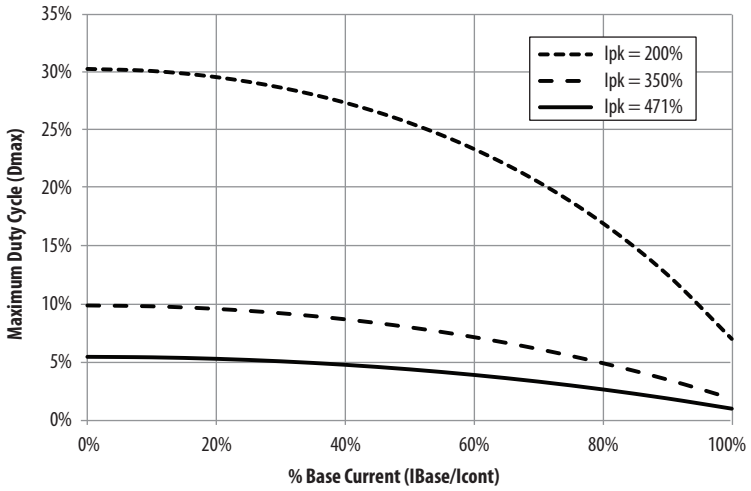
Peak Duty Cycle

Table 17 - Peak Duty Cycle Definition of Terms

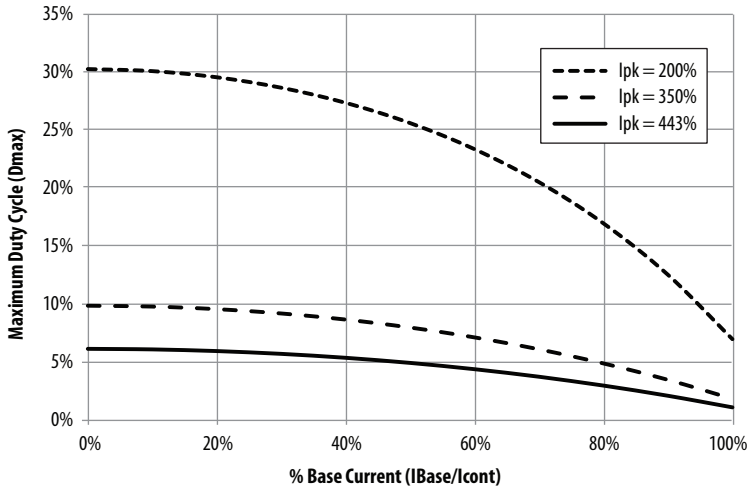
Term	Definition (1)
Continuous Current Rating (I_{Cont})	The maximum value of current that can be output continuously.
Peak Current Rating (I_{PKmax})	The maximum value of peak current that the drive can output. This rating is valid only for overload times less than T_{PKmax}.
Duty Cycle (D)	The ratio of time at peak to the Application Period and is defined as: $D = \frac{T_{PK}}{T} \times 100\%$
Time at Peak (T_{PK})	The time at peak current (I_{PK}) for a given loading profile. Must be less than or equal to T_{PKmax}.
Peak Current (I_{PK})	The level of peak current for a given loading profile. I_{PK} must be less than or equal to the Peak Current Rating (T_{PKMAX}) of the drive.
Base Current (I_{Base})	The level of current between the pulses of peak current for a given loading profile. I_{Base} must be less than or equal to the continuous current rating (I_{Cont}) of the drive.
Loading Profile	The loading profile is comprised of I_{PK}, I_{Base}, T_{PK}, and D (or T) values and completely specify the operation of the drive in an overload situation. These values are collectively defined as the Loading Profile of the drive.
Application Period (T)	The sum of the times at I_{PK} (T_{PK}) and I_{Base}.

(1) All current values are specified as rms.

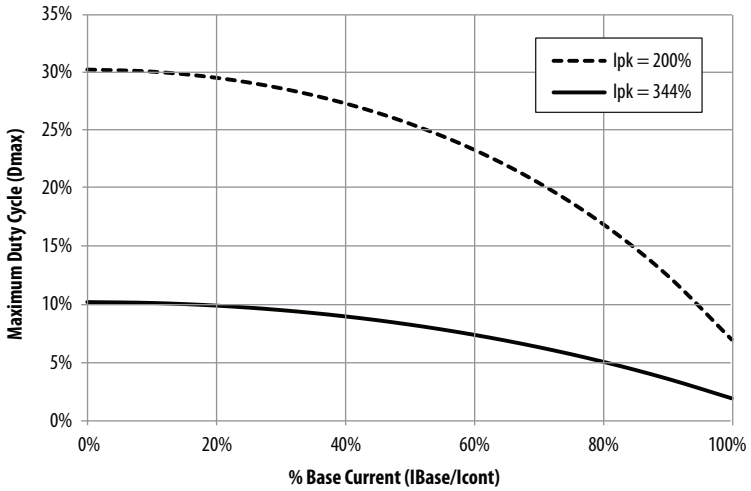
MDF-1003 Peak Inverter Overload (T_{PK} < 2.0 s)



MDF-1153 Peak Inverter Overload (T_{PK} < 2.0 s)



MDF-1304 Peak Inverter Overload (T_{PK} < 2.0 s)



Feedback Specifications

Kinetix 6000M integrated drive-motors are available with high performance digital encoders with multi-turn high resolution feedback:

- 524,288 counts per revolution
- High-resolution absolute position feedback within 4096 turns.

The IDM unit does not support an auxiliary feedback device.

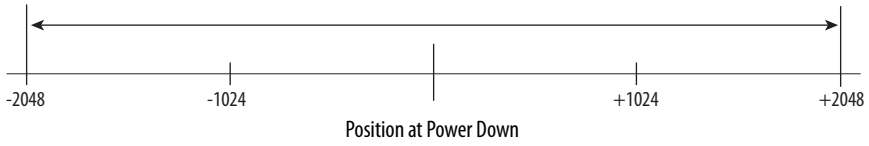
Absolute Position

The drive's absolute position feature tracks the position of the motor, within the multi-turn retention limits, while the drive is powered off. The absolute position feature is available on all IDM units.

Table 18 - Absolute Position Designator Examples

Encoder Type	Motor Cat. No. Designator	Motor Cat. No. Example
Hengstler BiSS	-Q	MDF-SB1003P-Q

Figure 20 - Absolute Position Retention Limits



Connecting the Kinetix 6000M System

This chapter provides procedures for wiring the integrated drive-motor system components.

Topic	Page
Basic Wiring Requirements	53
Grounding the IDM System	54
General IDM System Wiring	56
How to Bypass an IDM Unit	58
The Sercos Fiber-optic Ring	59
Ethernet Cable Connections	63

Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 6000M integrated drive-motor system. Refer to the Kinetix 6000 user manual, publication 2094-UM001, or the Kinetix 6200 user manual, publication 2094-UM002, for specific wiring information.

ATTENTION: Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2094 power rail and IPIM modules prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

IMPORTANT IDM system wiring differs from common PWM servo system wiring configurations in the following ways:

- Hybrid and network cables can be tie-wrapped together and occupy the same cable run
- Hybrid and network cables do not require physical segregation as a result of more effective wire shielding and improved grounding techniques.

This exception applies only to the hybrid and network cables that connect to an IPIM module or between IDM units, and does not apply to cabling elsewhere in a Kinetix drive system. Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

National Electrical Code, local electrical codes, special operating temperature, duty cycles, or system configurations take precedence over the information presented above and the values and methods provided in the document referenced above.

Routing the Power and Signal Cables

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic devices can be induced into I/O communication, or other sensitive low voltage signals. This can cause system faults and communication anomalies.

The hybrid cables and network cables are UL listed with 1000V and 105 ° C (221 ° F) insulation ratings, and can be routed in a common wireway.

Refer to Electrical Noise Reduction on page 27 for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

Grounding the IDM System

All equipment and components of a machine or process system should have a common earth ground point connected to chassis. A grounded system provides a ground path for short circuit protection. Grounding your modules and panels minimize shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis.

ATTENTION: The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system.

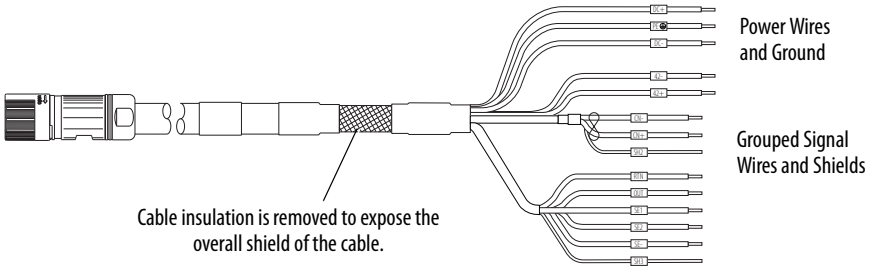
For CE grounding requirements, refer to Agency Compliance on page 19.

ATTENTION: High voltage can buildup on the shields of a hybrid cable, if the shield is not grounded. Verify that there is a connection to ground for all shields in the hybrid cable. Failure to observe these safety procedures could result in personal injury or damage to equipment.

Signal integrity is very important for successful operation of an integrated drive-motor system. You must be sure that all cables are properly grounded through the IPIM module to the ground plane of the Kinetix drive system.

- Verify that every cable shield directly connects to chassis ground.
- Clamp the exposed section of the hybrid cable shield in the cable (chassis) ground connection on the drive. Refer to Apply the Cable Shield Clamp.

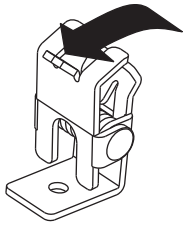
Figure 21 - Hybrid Cable Shields



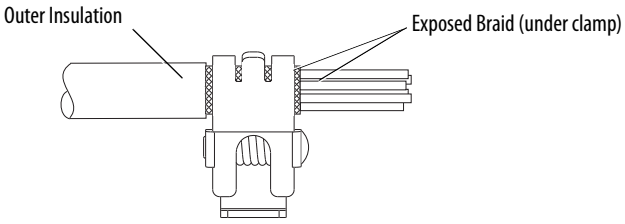
Apply the Cable Shield Clamp

The cable shield clamp assures a solid bond to the shield and secures the cable.

1. Depress the spring loaded clamp.



2. Position the exposed portion of the cable braid directly in line with the clamp.
3. Release the spring, making sure the cable and cable braid are held secure by the clamp.



General IDM System Wiring

ATTENTION: Arcing or unexpected motion can occur if cables are connected or disconnected while power is applied to the IDM system. Before working on the system, disconnect power and wait the full time interval indicated on the IPIM module warning label or verify the DC bus voltage at the IPIM module measures less than 50V DC.

Failure to observe this precaution could result in severe bodily injury or loss of life, and damage to the product will occur.

ATTENTION: Be sure that installed cables are restrained to prevent uneven tension or flexing at the cable connectors. Provide support at 3 m (10 ft) intervals throughout the cable run.

Excessive and uneven lateral force at the cable connectors may result in the connector's environmental seal opening and closing as the cable flexes, or wires separating at the cable gland.

Failure to observe these safety procedures could result in damage to the motor and its components.

IMPORTANT Building your own cables is not an option for the hybrid and network cables used in the IDM system.

Always form a drip loop in the cables directly before each cable enters and exits the IDM unit. A drip loop is a low spot in the cable that lets liquids gather and drip off the cable rather than flow along the cable to an electrical connection or the motor.

Connect the network and hybrid cables only after the IDM unit is mounted.

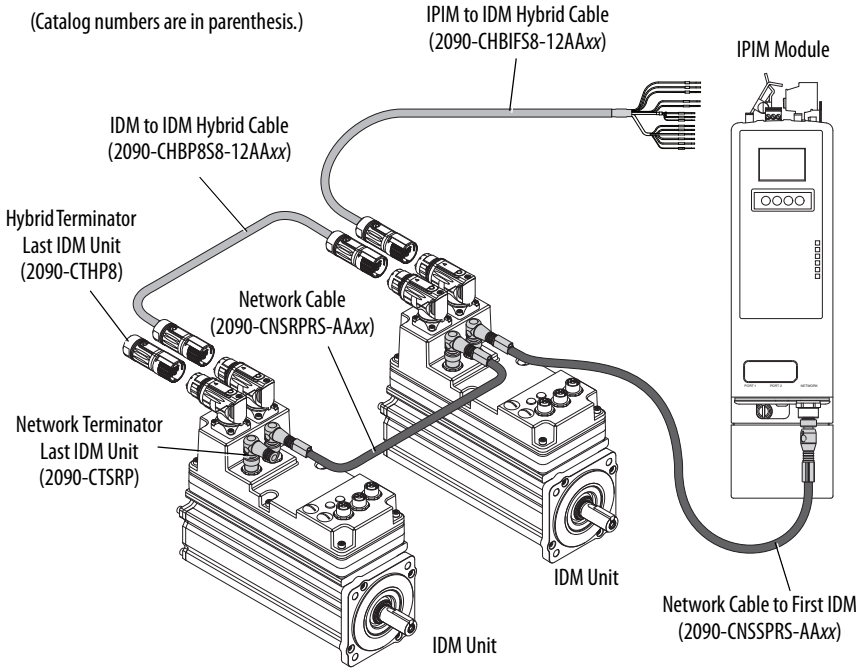
ATTENTION: Cable connectors must be properly aligned before the connection is secured with the recommended degrees of turn or torque value. Improper connector alignment is indicated by the need for excessive force, such as the use of tools, to fully seat connectors. Failure to observe these safety procedures could result in damage to the IDM unit, cables, and connector components.

Hybrid Cable

A hybrid cable, catalog number 2090-CHBIFS8-12AAxx, transfers DC bus power and inter-module communication signals from the IPIM module to the first IDM unit. Additional IDM units are daisy chained by using a 2090-CHBP8S8-12AAxx cable as shown in Figure 22.

ATTENTION: Verify that all connections are correct when wiring the connector plugs and that the plugs are fully engaged in the module connectors. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

Figure 22 - IDM System Wiring



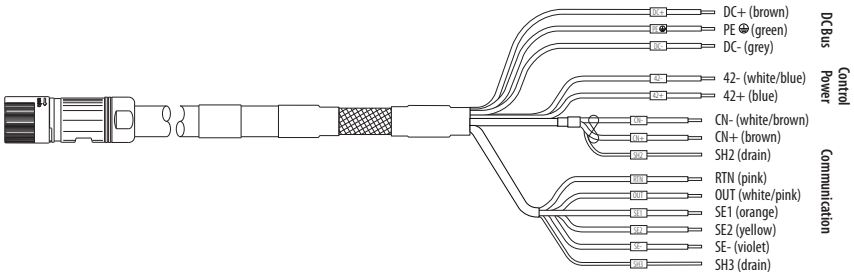
The colored rings on the hybrid cable connector and the mating cable must match: red-to-red or green-to-green.

Hand-tighten the knurled collar on a hybrid cable approximately 45 degrees to fully seat and lock the connector.

Wiring the Connectors

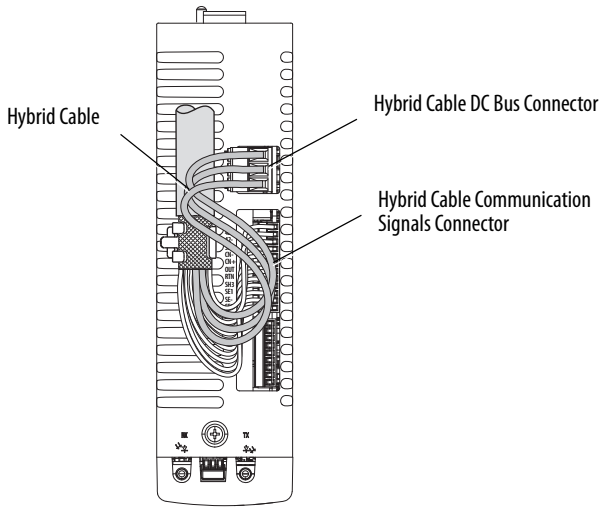
Use these guidelines as a reference when wiring the hybrid cable to the IPIM module.

Figure 23 - 2090-CHBIFS8-12AA*xx* Hybrid Cable



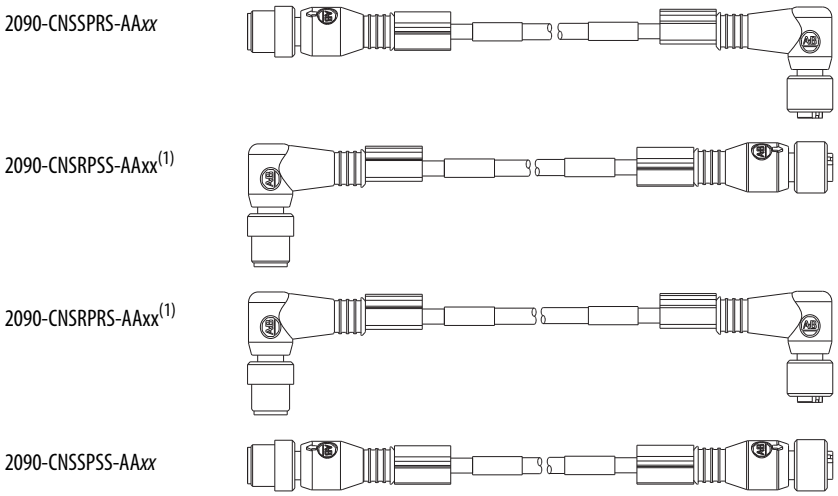
1. Route the cable/wires to the module.
2. Insert wires into connector plugs.
3. Tighten the connector screws.
   Refer to page 39 for torque specifications.
4. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.
5. Insert the connector plug into the module connector.

Figure 24 - Hybrid Cable Installed



Network Cable

The IDM system network is routed by using 2090-CNS*x*P*x*S-AA*xx* cables. A 2090-CNSSPRS-AA*xx* or 2090-CNSSPSS-AA*xx* cable is required for connection to the IPIM module.



(1) Not for connection to an IPIM module.

When installing network cables, torque the connector plug to 0.8...1.2 N•m (7.1...10.6 lb•in) to fully seat the contacts and secure the connection.

How to Bypass an IDM Unit

A 2090-CCPPS8S coupler cable joins two hybrid cables to bypass an IDM unit or extend the length of a cable. This can be desired when performing maintenance on a unit or to simply extend a hybrid cable. IDM to IDM cable lengths should not exceed 25 m (82.0 ft) during normal operation when a coupling cable is used.

The IDM network cables can be joined to together without the need of a coupler to bypass an IDM unit or extend network cables.

The Sercos Fiber-optic Ring

The sercos fiber-optic ring is connected by using the sercos receive (RX) and transmit (TX) connectors. Refer to Sercos Fiber-optic Connectors on page 41 for details. Refer to the documentation supplied with your Logix sercos interface module or PCI card for connector locations.

Plastic cable is available in lengths up to 32 m (105.0 ft). Glass cable is available in lengths between 50 m (164.2 ft) and 200 m (656.7 ft).

Connect the cable from transmit on the Logix module to receive on the first IPIM module, then transmit to receive (module to module), and from transmit on the last module back to receive on the Logix module.

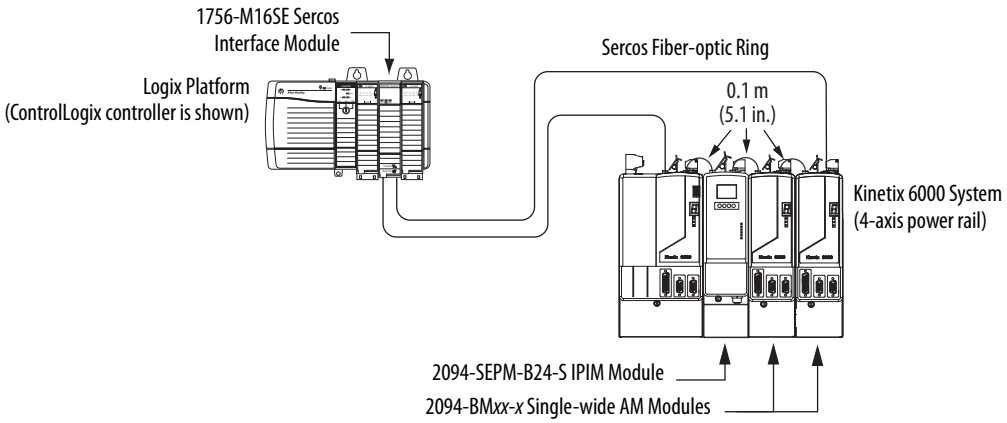
ATTENTION: To avoid damage to the sercos RX and TX connectors use only finger-tight torque when attaching the fiber-optic cables. Do not use a wrench or any other mechanical assistance. For more information, refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010.

IMPORTANT Clean the fiber-optic cable connectors prior to installation. Dust in the connectors can reduce signal strength. For more information, refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010.

The IPIM module has fiber-optic cable connectors positioned identical to the Kinetix 6000 (2094-BM*xx*-S) drives, the IPIM module uses the same fiber-optic cable lengths as the drive modules.

In the following example (Figure 25), all of the drive modules and the IPIM module are on the same sercos ring. The ring begins and ends at the 1756-M16SE sercos module. IDM units connected to the IPIM module (not shown for simplicity) are also part of this sercos ring.

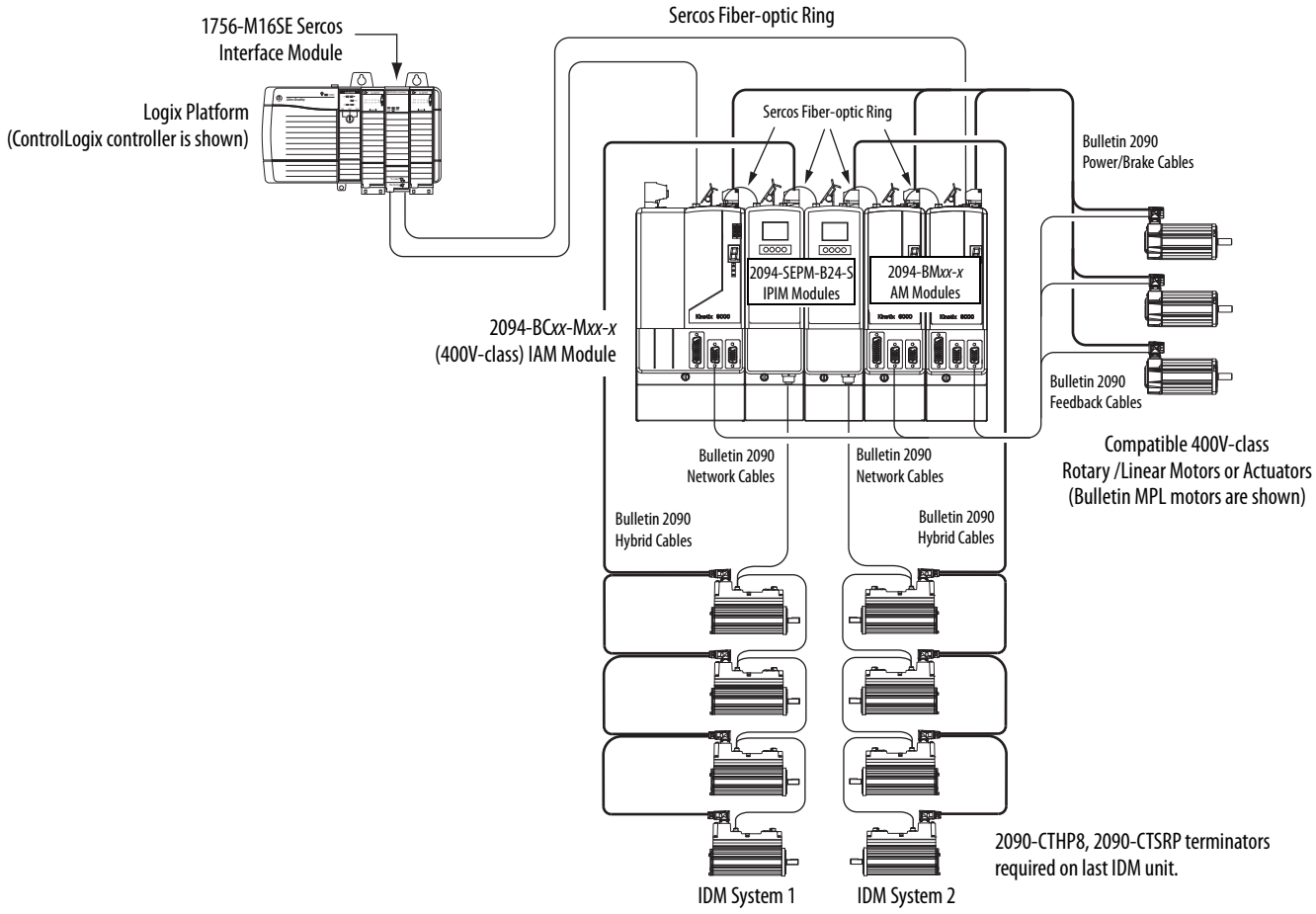
Figure 25 - Fiber-optic Cable Example - Logix Platform with IPIM Module



In this five-axis Bulletin 2094 power rail configuration, the IAM module and two AM modules power three of the axes and two IPIM modules are each connected to four IDM units. All eleven axes are on the same sercos ring.

IMPORTANT	It is not required that all Kinetix 6000 drives be on the same sercos ring; however, it is required that all IDM units be on the same sercos ring as the IPIM module they are connected to.

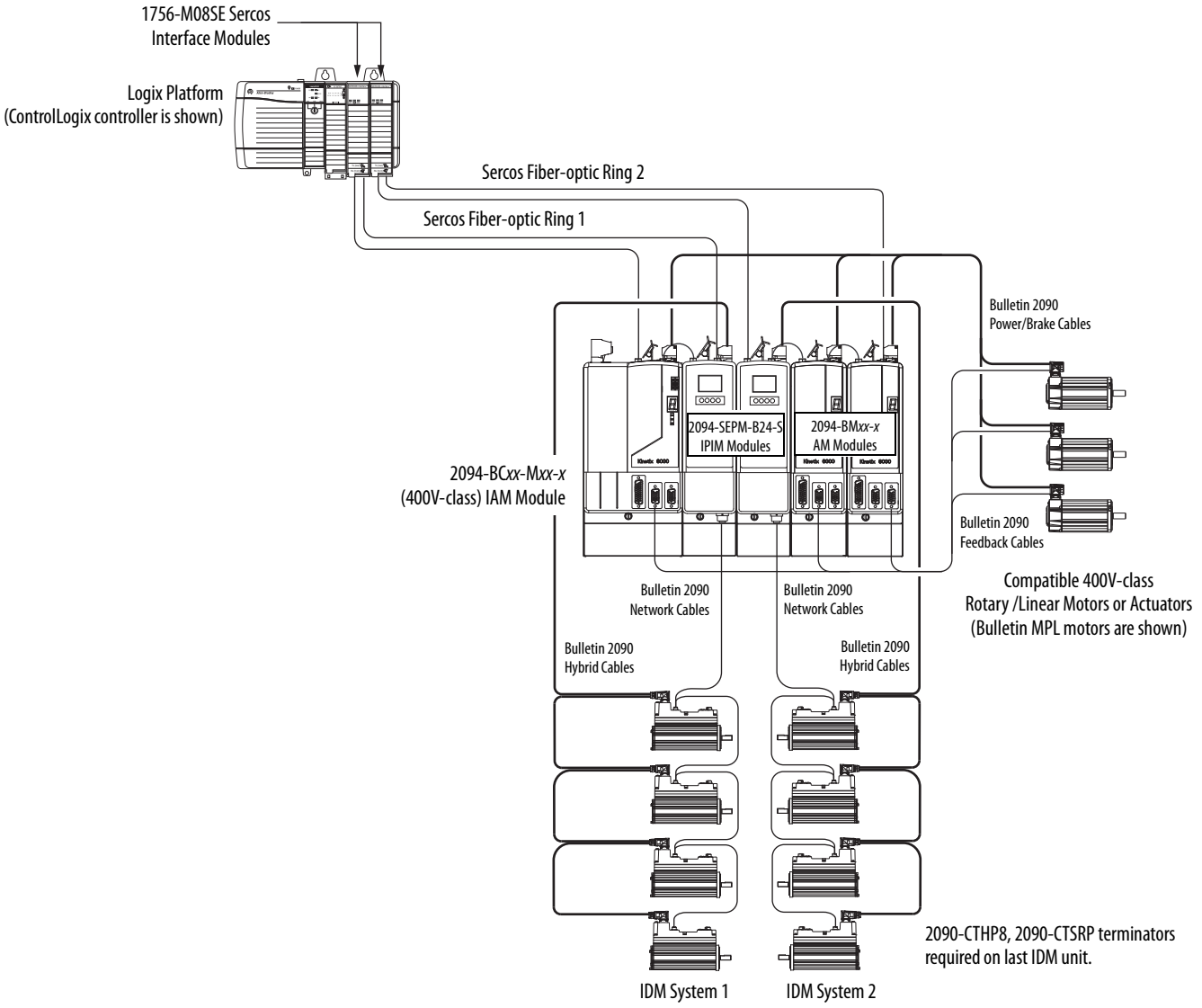
Figure 26 - Kinetix 6000M Network Cable Example - IPIM Module to IDM Units (1 sercos ring)



This configuration has the same drive modules and IPIM modules as shown in Figure 26, except the five modules are split between two sercos rings. Each ring has its own 1756-M08SE sercos module in the ControlLogix controller chassis.

IMPORTANT It is not required that all Kinetix 6000 drives be on the same sercos ring; however, it is required that all IDM units be on the same sercos ring as the IPIM module they are connected to.

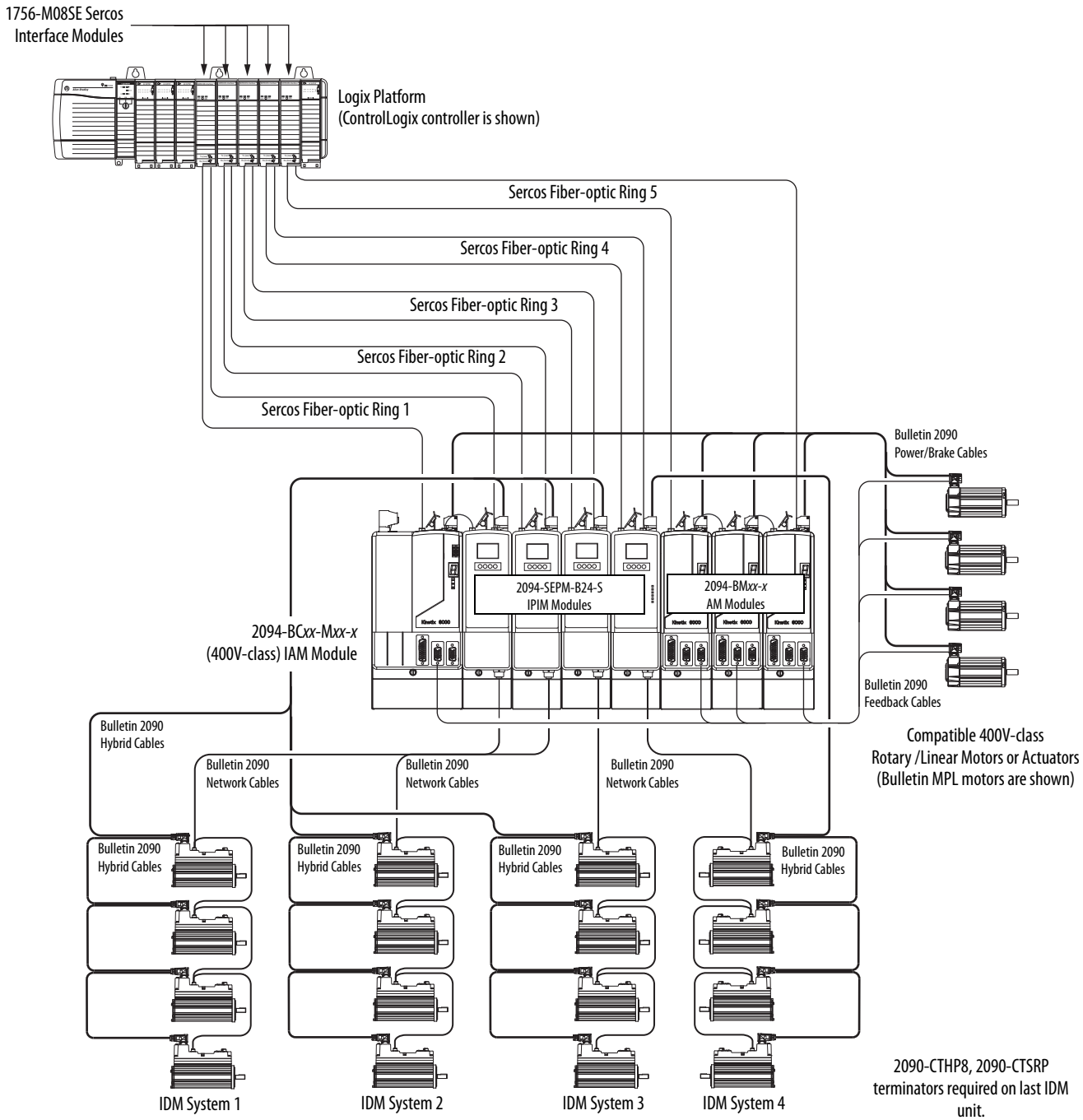
Figure 27 - Kinetix 6000M Network Cable Example - IPIM Module to IDM Units (2 sercos rings)



In this configuration, the 8-axis Bulletin 2094 power rail has four drive modules and four IPIM modules. Each IPIM module is connected to four IDM units. There are five sercos rings and each ring has its own 1756-M08SE sercos module in the ControlLogix controller chassis.

IMPORTANT	It is not required that all Kinetix 6000 drives be on the same sercos ring; however, it is required that all IDM units be on the same sercos ring as the IPIM module they are connected to.

Figure 28 - Kinetix 6000M Network Cable Example - IPIM Module to IDM Units (5 sercos rings)


1756-M08SE Sercos Interface Modules
Logix Platform (ControlLogix controller is shown)
Sercos Fiber-optic Ring 5
Sercos Fiber-optic Ring 4
Sercos Fiber-optic Ring 3
Sercos Fiber-optic Ring 2
Sercos Fiber-optic Ring 1
Bulletin 2090 Power/Brake Cables
2094-SEPM-B24-S IPIM Modules
2094-BMxx-x AM Modules
2094-BCxx-Mxx-x (400V-class) IAM Module
Bulletin 2090 Feedback Cables
Bulletin 2090 Hybrid Cables
Bulletin 2090 Network Cables
Bulletin 2090 Network Cables
Bulletin 2090 Network Cables
Compatible 400V-class Rotary /Linear Motors or Actuators (Bulletin MPL motors are shown)
Bulletin 2090 Hybrid Cables
Bulletin 2090 Hybrid Cables
Bulletin 2090 Hybrid Cables
Bulletin 2090 Hybrid Cables
IDM System 1
IDM System 2
IDM System 3
IDM System 4
2090-CTHP8, 2090-CTSRP terminators required on last IDM unit.

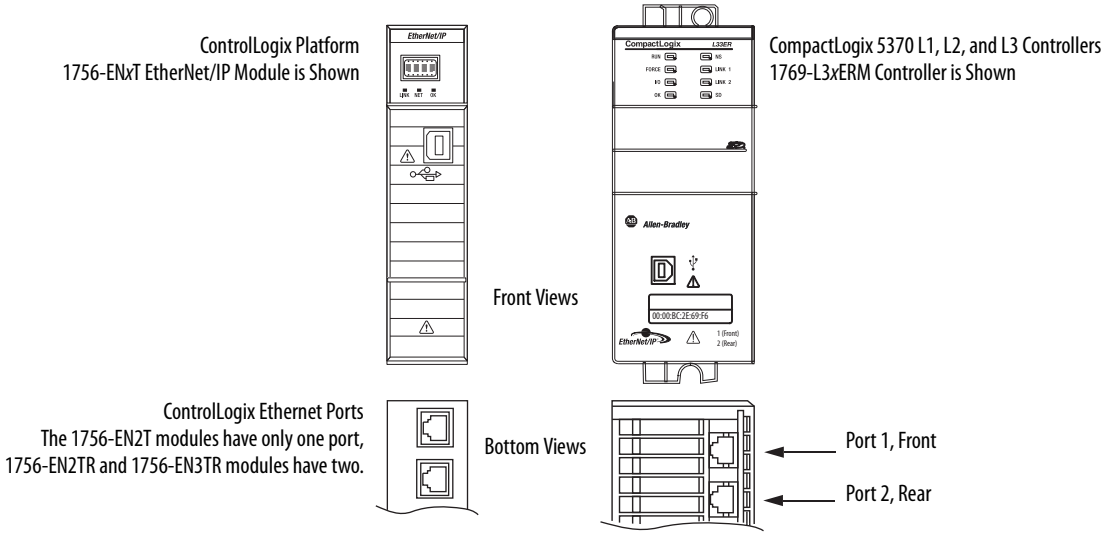
Ethernet Cable Connections

This procedure assumes you have your ControlLogix or CompactLogix EtherNet/IP module and Bulletin 2094 control modules mounted and are ready to connect the Ethernet network cables.

The EtherNet/IP network is connected by using the PORT 1 and/or PORT 2 connectors. The IPIM module uses the EtherNet/IP network only for configuring the Logix program. Refer to page 42 to locate the Ethernet connector on your IPIM module.

Refer to the Figure 29 to locate the connector on your EtherNet/IP controller module.

Figure 29 - ControlLogix and CompactLogix Ethernet Port Locations


ControlLogix Platform
1756-ENxT EtherNet/IP Module is Shown
CompactLogix 5370 L1, L2, and L3 Controllers
1769-L3xERM Controller is Shown
Front Views
ControlLogix Ethernet Ports
The 1756-EN2T modules have only one port,
1756-EN2TR and 1756-EN3TR modules have two.
Bottom Views
Port 1, Front
Port 2, Rear

Notes:

Configuring the Kinetix 6000M System

This chapter provides procedures for configuring your Kinetix 6000M system components with your Logix sercos module.

Topic	Page
Understanding the IPIM Module Display	66
Configuring the IPIM Module	69
Configuring the IDM Unit	70
Add-on Profiles	73
Configure the Logix Sercos Interface Module	73
Apply Power to the System	82
Test and Tune the Axes	83

TIP Before you begin, make sure you know the catalog number for each IDM unit, IPIM module, and the Logix module in your motion control application.

Configure the Kinetix 6000M Integrated Drive-motor System

Configuration for the Kinetix 6000M integrated drive-motor system follows a procedure similar to what is described in the Kinetix 6000 Multi-axis Servo Drives User Manual and Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual. You will assign each IDM unit a node address and configure the IDM system in RSLogix 5000 software.

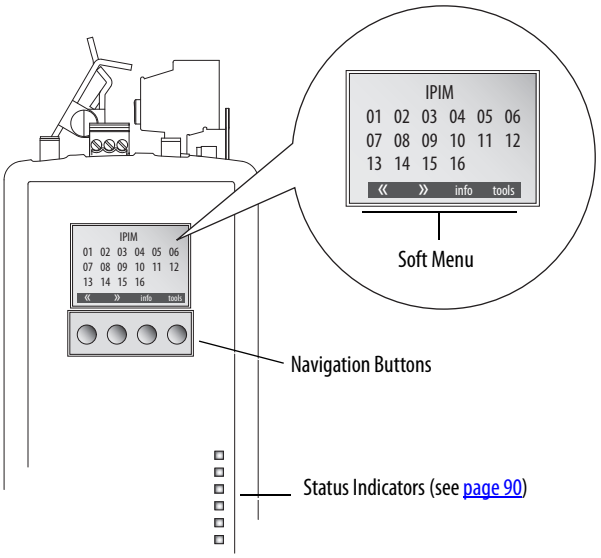
The IPIM module does not require configuration for your IDM units to be configured in the sercos ring. However, you can include the IPIM module in your RSLogix 5000 project by connecting it to a configured Ethernet module in the Logix chassis and adding it under the Ethernet module in the I/O configuration tree. An Add-On Profile is also needed to use the IPIM module in the RSLogix 5000 project, and as a result you can view IPIM module status information in RSLogix 5000 software and use it in your Logix program. The Ethernet connection is also used to upgrade the IPIM module firmware by using ControlFLASH software.

TIP The factory default communication rate for all Kinetix 6000 modules is 4 Mbps. The modules must be changed to 8 Mbps to be compatible with the Kinetix 6000M.

Understanding the IPIM Module Display

The IPIM module has six status indicators (see Interpret Status Indicators on page 90) and a four-line LCD display. The indicators and display are used to monitor the system status, set network parameters, and troubleshoot faults. Four navigation buttons are located directly below the display and are used to select items from a soft menu.

Figure 30 - IPIM Module LCD Display

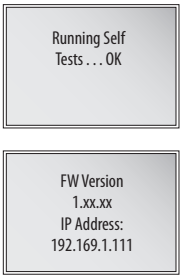


The soft menu provides a changing selection that will correspond to the current display. Use the navigation buttons to perform the following.

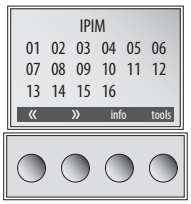
« »	Selecting either arrow will move the selection to the next (or previous) item or value. Depending on the menu displayed, both arrows may not be shown.
∧ ∨	Selecting either arrow will move the selection to the next menu item. It will also change a selected value. Depending on the menu or item displayed, both arrows may not be shown.
back	Discards changes and returns to the previous screen or home.
cancel	Discards any changes and returns to the home display.
enter	Accepts current selection/value.
info	Selects the Information display for the IPIM or a selected IDM unit.
home	Selecting “home” will discard changes and return to the home display.
tools	Displays the tools menu.
save	Accepts the current selection/value.

Startup Sequence

On initial powerup, the IPIM module performs a self test of the system. Upon successful completion, the following confirmation is displayed, followed by the firmware version and IP address.



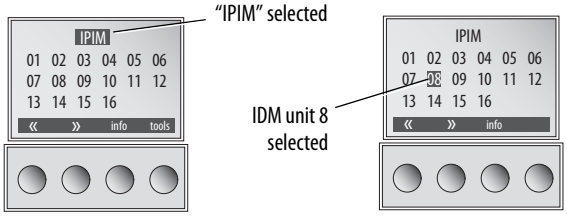
Next, the home screen displays the address of each connected IDM unit.



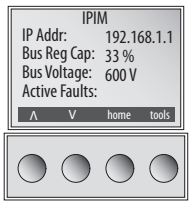
If an IDM unit is reporting a fault, the IDM address is either underlined or outlined. It is outlined for severe faults and underlined for less severe faults.

Information Display

Use the arrows to select “IPIM” or a specific IDM unit.



Pressing “info” displays a new screen with detailed information about the IPIM module or selected IDM unit.



IPIM Information

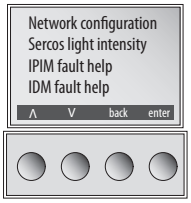
IDM Information

The following information is displayed.

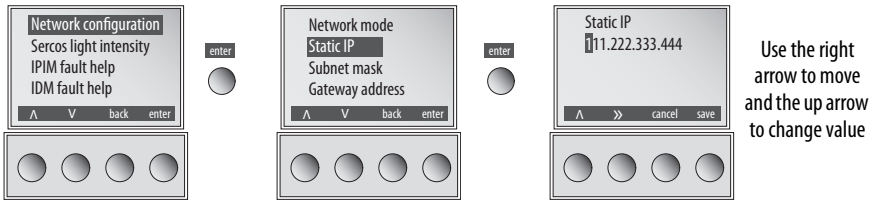
IPIM Information		IDM Information	
Module Status:	- IP Address - OK -Standby (OK, but no CIP connection) -Faulted -Init Fault (Requires reboot)	Status:	Displays IDM status values.
Bus Reg Cap	Percent of shunt capacity being utilized.	Safety:	"Motion-allowed" or "Safe-off."
Active Faults:	Active faults (one per line) will be displayed.	Sercos Phase:	Current sercos phase of the IDM: 0 -5.
Utilization:	Percent of continuous DC bus current.	Active Faults:	Active faults (one per line) will be displayed.

Tools Menu

The tools menu provides network setup, sercos light intensity adjustment and fault help.



To edit a menu item or value, use the arrow keys to select the desired item, then press "enter." The up arrow lets you increment the value that is highlighted. Values will rollover when reaching the end of the list.



The tools menu provides viewing/editing of the following.

Selection	Description	
Network configuration	Mode	Select Static or DHCP configuration.
	IP Address	Edits the IP address.
	Subnet mask	Edits the subnet mask.
	Gateway address	Edits gateway address.
	Primary address	Edits primary name server IP address.
	Secondary Name Server	Edit the secondary name server IP address.
Sercos light intensity	Selects high or low intensity. Changes to the light intensity will take effect immediately and be stored in non-volatile memory. The default setting is "High."	
IPIM fault help	Displays help text for the selected IPIM fault.	
IDM fault help	Displays help text for the selected IDM fault.	

Configuring the IPIM Module

You can include the IPIM module in your RSLogix 5000 project by connecting it to a configured Ethernet module in the Logix chassis and adding it under the Ethernet module in the I/O configuration tree. As a result, you can view the IPIM module status information in RSLogix 5000 software and use it in your Logix program. To select the IPIM module in RSLogix 5000 software, version 20, you must load an Add-on Profile (see page 73).

Setting the IPIM Module Network Address

To perform monitoring, diagnostics, and upgrade firmware, it is necessary to program the following using the LCD display:

- Mode - Static or DHCP
- IP address
- Gateway
- Subnet mask

Settings are stored in non-volatile memory. You can select a static address, or enable DHCP. IP addressing may also be changed through the Module Configuration dialog in RSLinx software. Changes to the IP addressing take effect immediately. The factory setting of the IP address is the static address 192.168.1.1. Refer to Understanding the IPIM Module Display on page 66 for programming guidelines.

Follow these steps to program the network settings:

1. Apply control power.
2. After initialization is complete and the home screen is displayed, select: tools>Network configuration>Net mode.
3. Use the arrow keys to select Static or DHCP.
4. Press “save.”
5. Select tools>Network configuration>Net mode>Static IP.
6. Use the right arrow to select the first digit to change.
7. Use the up arrow to increment the value until the desire value is displayed. Then use the right arrow to select the next digit and so on. Continue until the IP address is correct.
8. Press “save.”
9. Repeat step 1 through step 8 to set the subnet mask and gateway address.
10. Save your settings and remove control power.

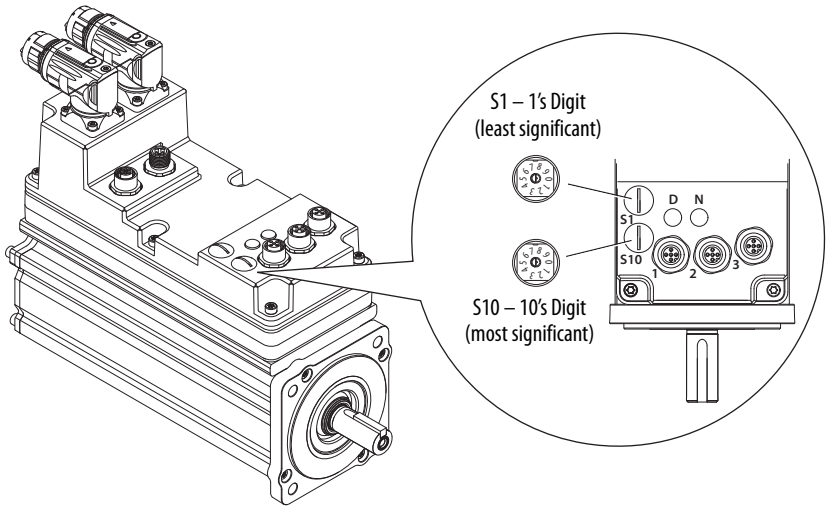
Configuring the IDM Unit

Setting the Node Address

The node address is set by switches on each IDM unit. This address is the actual sercos node address, not an offset from the IAM module. The address is read at power up, so if the switch settings are changed while power is applied, the changes do not take effect until the next power cycle.

Refer to Figure 31 and remove the two protective covers to gain access to the switches. Using a small screwdriver, rotate the switches to the proper setting. Replace covers and torque to 0.6 N•m (5 lb•in), repeat for any other units.

Figure 31 - Node Address Switches



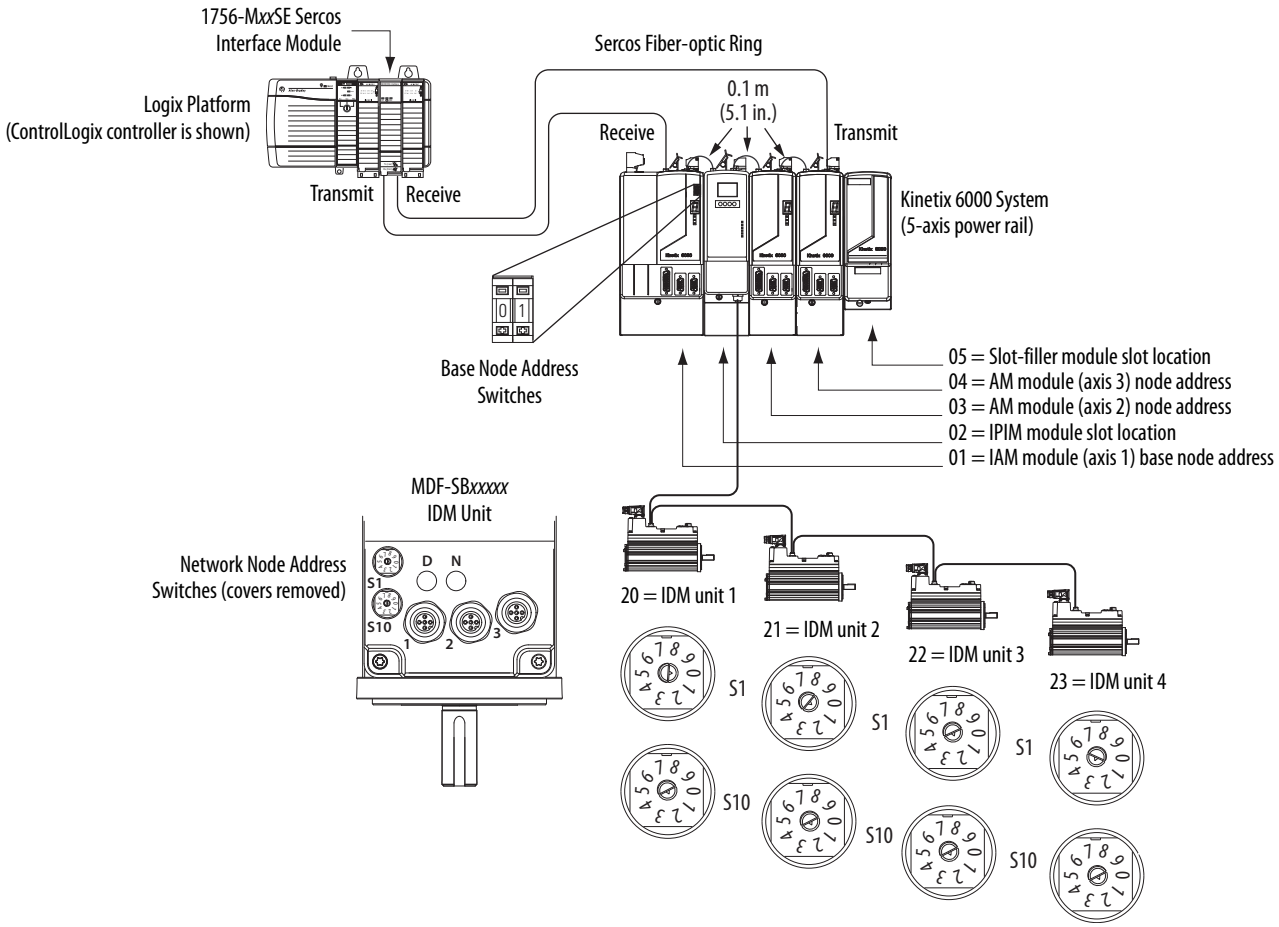
In the following example (Figure 32), the Kinetix 6000 power rail contains two single-wide axis modules and one IDM system. A sercos node address is not assigned to the slot-filler or the IPIM module. However, the system identifies both modules with slot locations.

Node addresses 02 and 05 are available for any of the IDM units, but to avoid confusion, the node addressing for the IDM units was started at 20. Unlike axis modules, each IDM unit has switches that determine its node address. In example 1, the IDM unit node addressing is sequential, but it doesn't have to be.

IMPORTANT Creating a duplicate node address between the axis modules mounted on the power rail and the IDM system generates error code E50. Each node address on the sercos ring must be unique within the range of 01…99.

IMPORTANT Slot-filler modules must be used to fill any unoccupied slot on the power rail. However, you can replace slot-filler modules with AM modules or the 2094-BSP2 shunt module (maximum one 2094-BSP2 shunt module per power rail).

Figure 32 - Node Addressing Example 1

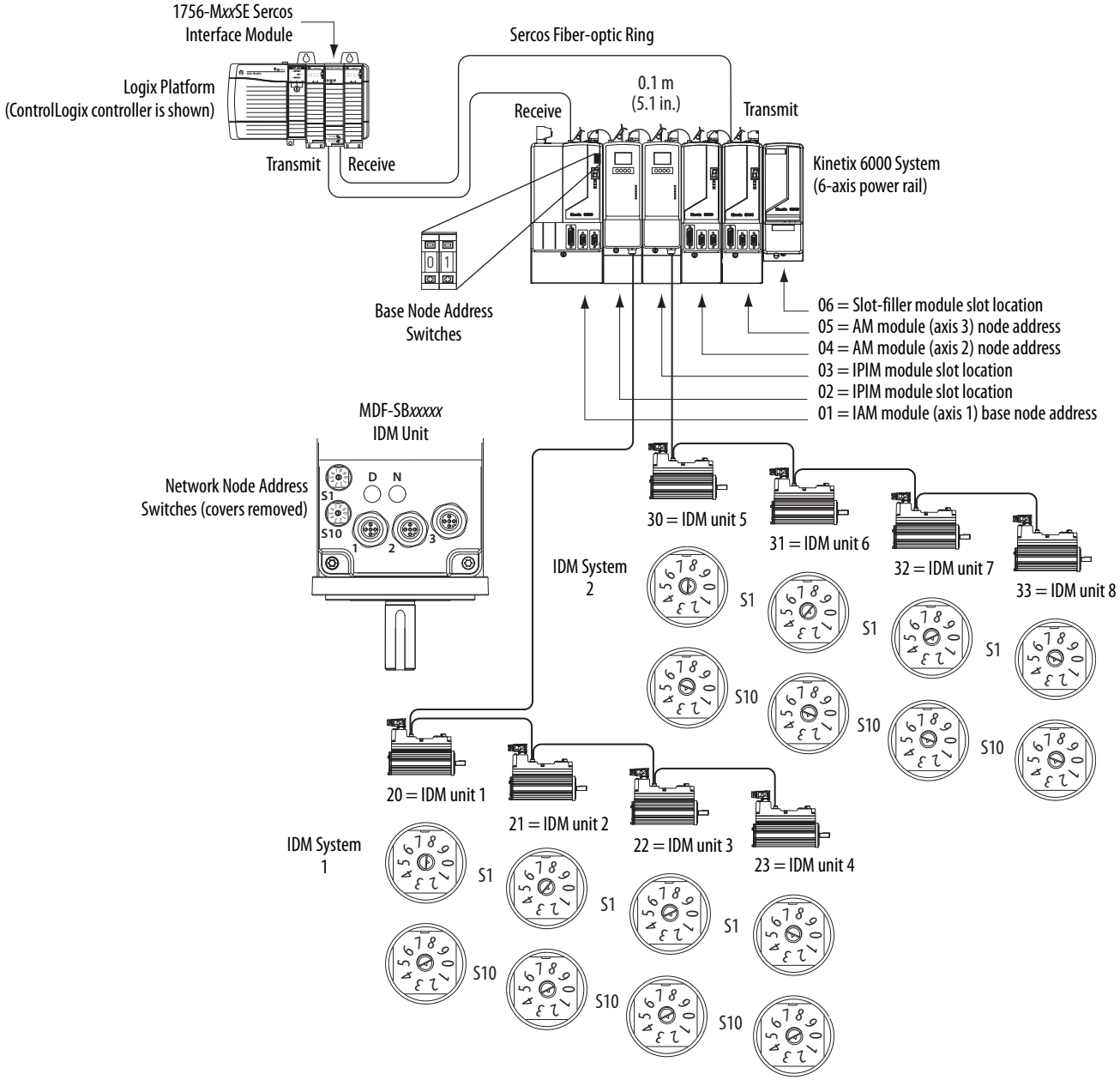


In example 2 (Figure 33), the Kinetix 6000 power rail contains two single-wide axis modules and two IDM systems. A sercos node address is not assigned to the slot-filler or the IPIM module, but the system identifies both with slot locations.

Node addressing for the IDM system example 2 is similar to the first. Each IDM unit has switches that determine its node address. In this example, the IDM unit node addressing starts at 30 and is sequential.

IMPORTANT Creating a duplicate node address between the axis modules mounted on the power rail and the IDM system generates error code E50. Each node address on the sercos ring must be unique within the range of 01…99.

Figure 33 - Node Addressing Example 2


1756-M*xx*SE Sercos Interface Module
Logix Platform (ControlLogix controller is shown)
Transmit
Receive
Sercos Fiber-optic Ring
0.1 m (5.1 in.)
Receive
Transmit
Kinetix 6000 System (6-axis power rail)
Base Node Address Switches
06 = Slot-filler module slot location
05 = AM module (axis 3) node address
04 = AM module (axis 2) node address
03 = IPIM module slot location
02 = IPIM module slot location
01 = IAM module (axis 1) base node address
MDF-SB*xxxxx* IDM Unit
Network Node Address Switches (covers removed)
S1
S10
D
N
30 = IDM unit 5
31 = IDM unit 6
32 = IDM unit 7
33 = IDM unit 8
IDM System 2
20 = IDM unit 1
21 = IDM unit 2
22 = IDM unit 3
23 = IDM unit 4
IDM System 1

Add-on Profiles

To select the IPIM module in RSLogix 5000 software, version 20, you must load an Add-on Profile from www.ab.com.

To navigate to the Add-on Profiles, follow this path:

- Technical Support
- Software Updates, Firmware and Other Downloads
- RSLogix 5000 I/O Modules Add-On-Profiles

You will be required to establish a login and provide the serial number of your drive to access the download file.

Configure the Logix Sercos Interface Module

This procedure assumes that you have wired your Kinetix drive system and have configured the communication rate and optical power switches.

For help using RSLogix 5000 software as it applies to configuring the ControlLogix, CompactLogix, or SoftLogix sercos modules, refer to Additional Resources on page 7.

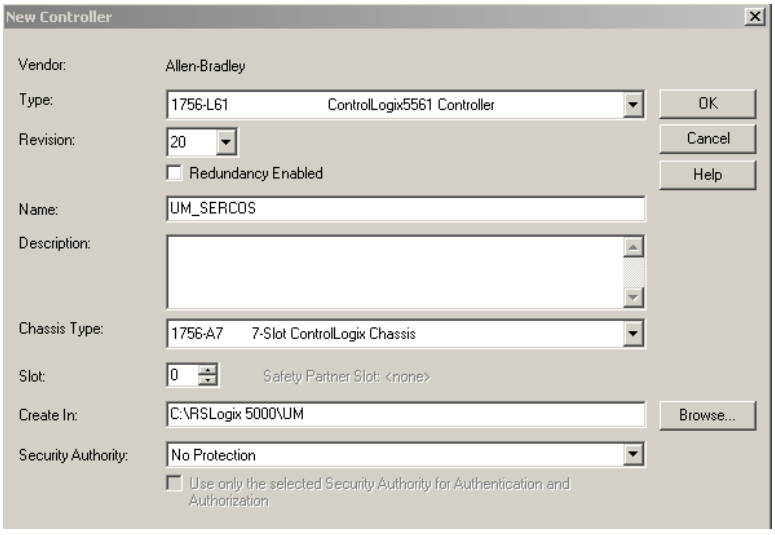
IMPORTANT RSLogix 5000 software, version 20.00 or later, is required.

Configure the Logix Controller

Follow these steps to configure the Logix controller.

1. Apply power to your Logix chassis containing the sercos interface module/ PCI card and open your RSLogix 5000 software.
2. From the File menu, choose New.

   The New Controller dialog box opens.

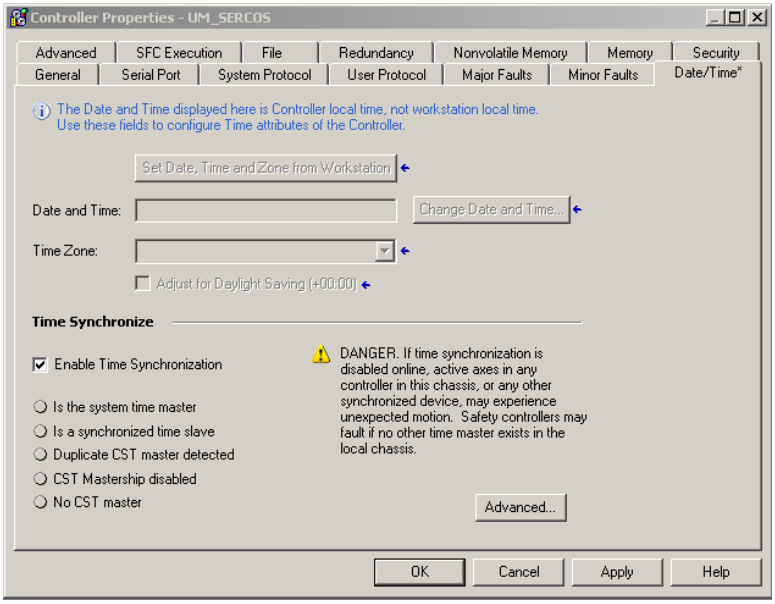


3. Configure the new controller.

a. From the Type pull-down menu, choose the controller type.
b. From the Revision pull-down menu, choose the revision (V20).
c. Type the file Name.
d. From the Chassis Type pull-down menu, choose the chassis.
e. Enter the Logix processor slot.

4. Click OK.
5. From the Edit menu, choose Controller Properties.

   The Controller Properties dialog box opens.



6. Click the Date/Time tab.
7. Check Enable Time Synchronization.

   This assigns the controller as the Grandmaster clock. The motion modules set their clocks to the module you assign as the Grandmaster.

IMPORTANT	You can assign only one module in the Logix chassis as the Grandmaster clock.

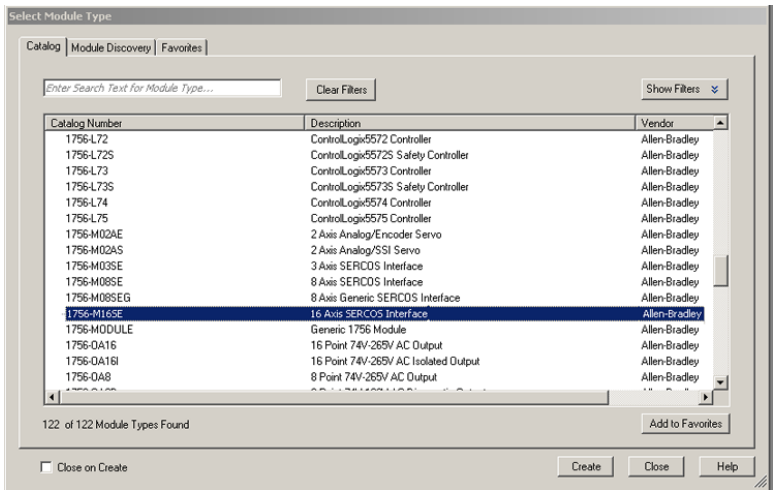
8. Click OK.

Configure the Logix Module

Follow these steps to configure the Logix module.

1. Right-click I/O Configuration in the Controller Organizer and choose New Module.

   The Select Module dialog box opens.

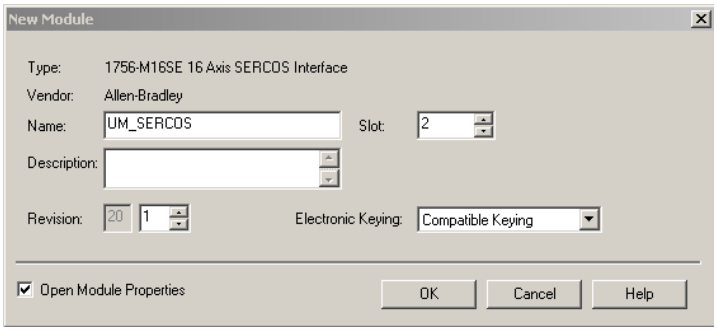


2. Scroll to select the sercos module as appropriate for your actual hardware configuration.

   In this example, the 1756-M16SE module is selected.

3. Click Create.

   The New Module dialog box opens.

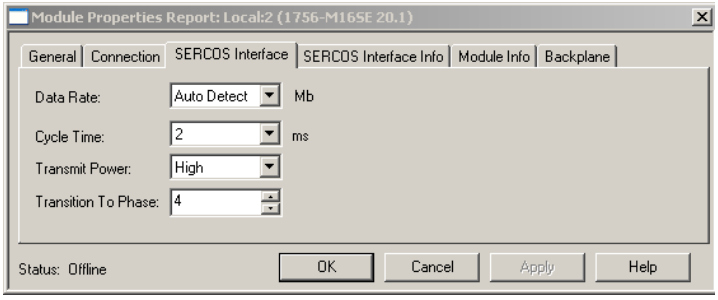


4. Configure the new module.
   a. Type the module Name.
   b. Enter the Logix sercos module slot (leftmost slot = 0).
   c. Check Open Module Properties.
5. Click OK.

   Your new module appears under the I/O Configuration folder in the Controller Organizer and the Module Properties dialog box opens.

TIP The IDM system data rate is fixed at 8 Mbps.

6. Verify that the data rate DIP switches on the IAM module and any AM modules on the same sercos ring are set to 8 Mbps.
7. Click the SERCOS Interface tab.



8. From the Data Rate pull-down menu choose 8 Mb or choose the Auto Detect setting.
9. From the Cycle Time pull-down menu, choose the Cycle Time according to the table below.

Data Rate	Number of Axes	Cycle Time
8 Mbps (1)	Up to 4	0.5 ms
	Up to 8	1 ms
	Up to 16	2 ms

(1) The Kinetix 6000M system supports only 8 Mbps.

TIP The factory default data rate setting for all Kinetix 6000 modules is 4 Mbps.

TIP The number of axes/module is limited to the number of axes as shown in the table below.

Logix Sercos Module	Number of Axes	Data Rate
1756-M03SE or 1756-L60M03SE	Up to 3	8 Mbps
1756-M08SE	Up to 8	
1756-M16SE or 1784-PM16SE	Up to 16	
1768-M04SE	Up to 4	

10. From the Transmit Power pull-down menu, choose High.

    The default setting is High; however, this setting is dependent on the cable length (distance to next receiver) and cable type (glass or plastic).
11. Enter the Transition to Phase setting.

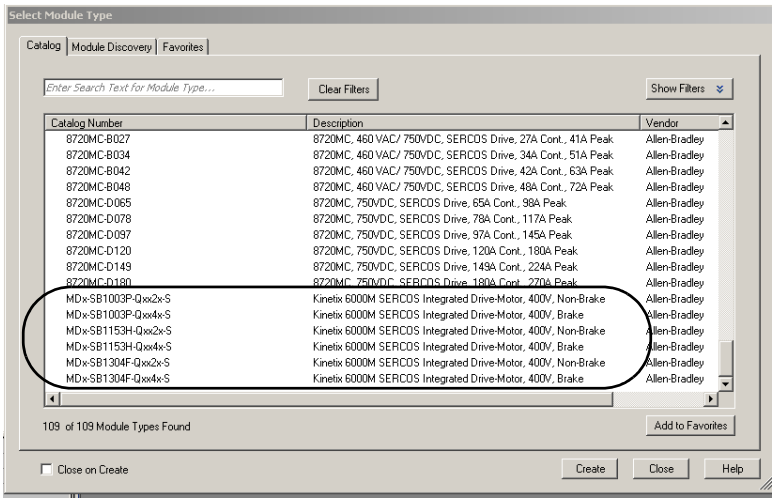
    The Transition to Phase default setting is 4 (phase 4). The Transition to Phase setting stops the ring in the phase specified.
12. Click OK.
13. Repeat step 1 through step 12 for each Logix module.

Configure the IDM Units

Follow these steps to configure the IDM units.

1. Right-click the Logix module you just created and choose New Module.

   The Select Module dialog box opens.

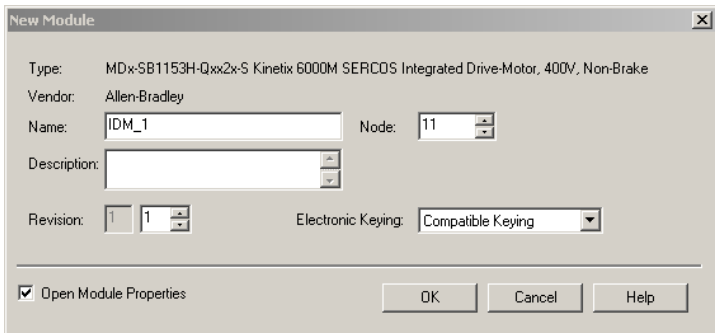

Select Module Type
Catalog
Module Discovery
Favorites
Enter Search Text for Module Type...
Clear Filters
Show Filters
Catalog Number
Description
Vendor
8720MC-B027 8720MC, 460 VAC/ 750VDC, SERCOS Drive, 27A Cont., 41A Peak Allen-Bradley
8720MC-B034 8720MC, 460 VAC/ 750VDC, SERCOS Drive, 34A Cont., 51A Peak Allen-Bradley
8720MC-B042 8720MC, 460 VAC/ 750VDC, SERCOS Drive, 42A Cont., 63A Peak Allen-Bradley
8720MC-B048 8720MC, 460 VAC/ 750VDC, SERCOS Drive, 48A Cont., 72A Peak Allen-Bradley
8720MC-D065 8720MC, 750VDC, SERCOS Drive, 65A Cont., 98A Peak Allen-Bradley
8720MC-D078 8720MC, 750VDC, SERCOS Drive, 78A Cont., 117A Peak Allen-Bradley
8720MC-D097 8720MC, 750VDC, SERCOS Drive, 97A Cont., 145A Peak Allen-Bradley
8720MC-D120 8720MC, 750VDC, SERCOS Drive, 120A Cont., 180A Peak Allen-Bradley
8720MC-D149 8720MC, 750VDC, SERCOS Drive, 149A Cont., 224A Peak Allen-Bradley
8720MC-D180 8720MC, 750VDC, SERCOS Drive, 180A Cont., 270A Peak Allen-Bradley
MDx-SB1003P-Qxx2x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Non-Brake Allen-Bradley
MDx-SB1003P-Qxx4x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Brake Allen-Bradley
MDx-SB1153H-Qxx2x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Non-Brake Allen-Bradley
MDx-SB1153H-Qxx4x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Brake Allen-Bradley
MDx-SB1304F-Qxx2x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Non-Brake Allen-Bradley
MDx-SB1304F-Qxx4x-S Kinetix 6000M SERCOS Integrated Drive-Motor, 400V, Brake Allen-Bradley
109 of 109 Module Types Found
Add to Favorites
Close on Create
Create
Close
Help

2. Scroll to select the IDM unit appropriate for your actual hardware configuration.

IMPORTANT	To configure IDM units (catalog numbers MDF-SB*xxxxx*) you must be using RSLogix 5000 software, version 20.01 or later. Version 20.00 can be used if the motion database has been updated.

3. Click Create.

   The New Module dialog box opens.



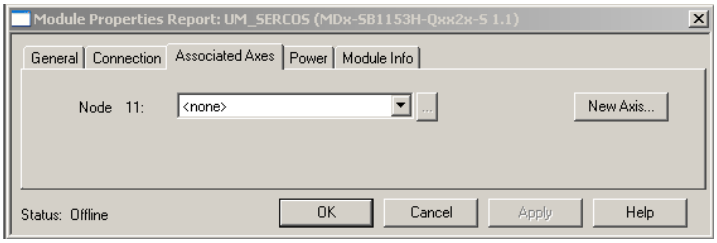
4. Configure the new module.
   a. Type the module Name.
   b. Enter the Node address.

   Set the node address in the software to match the node setting on the IDM unit. Refer to Setting the Node Address on page 70.

   c. Check Open Module Properties.

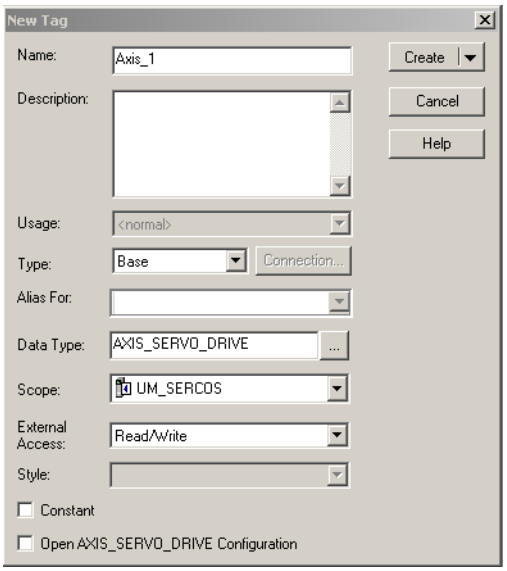
5. Click OK.

6. Click the Associated Axes tab.



7. Click New Axis.

   The New Tag dialog box opens.



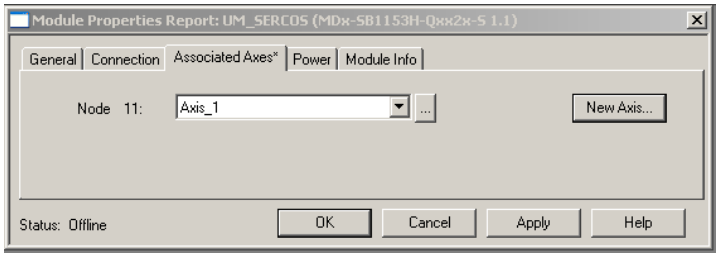
8. Type the axis Name.

   AXIS_SERVO_DRIVE is the default Data Type.

9. Click Create.

   The axis appears under the Ungrouped Axes folder in the Controller Organizer.

10. Assign your axis to Node 1.



TIP Auxiliary feedback is not supported by the IDM units.

11. Click OK.

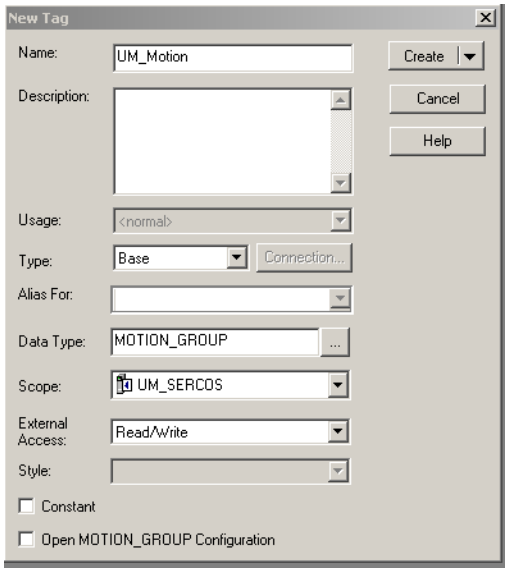
12. Repeat step 1 through step 11 for each IDM unit.

Configure the Motion Group

Follow these steps to configure the motion group.

1. Right-click Motion Groups in the Controller Organizer and choose New Motion Group.

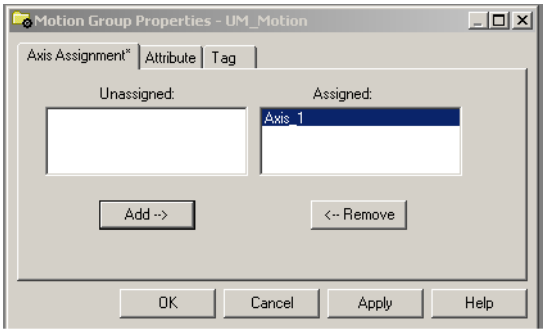
   The New Tag dialog box opens.



2. Type the new motion group Name.
3. Click OK.

   The new motion group appears under the Motion Groups folder.
4. Right-click the new motion group and choose Properties.

   The Motion Group Properties dialog box opens.



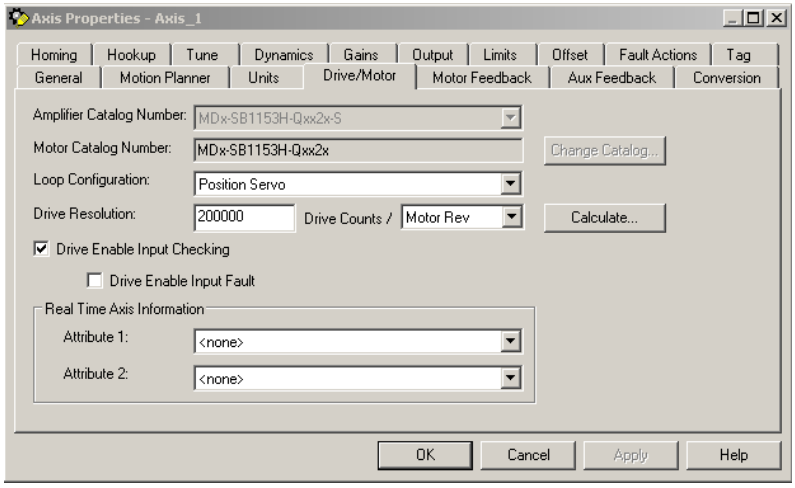
5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

Configure Axis Properties

Follow these steps to configure the Axis properties.

1. Right-click an axis in the Controller Organizer and choose Properties.

   The Axis Properties dialog box opens.

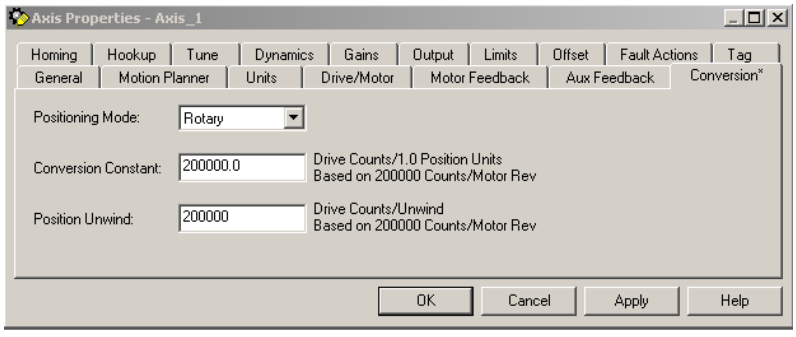


2. On the Drive/Motor tab, check Drive Enable Input Checking.

   When checked (default), means a hard drive-enable input signal is required. Uncheck to remove that requirement.

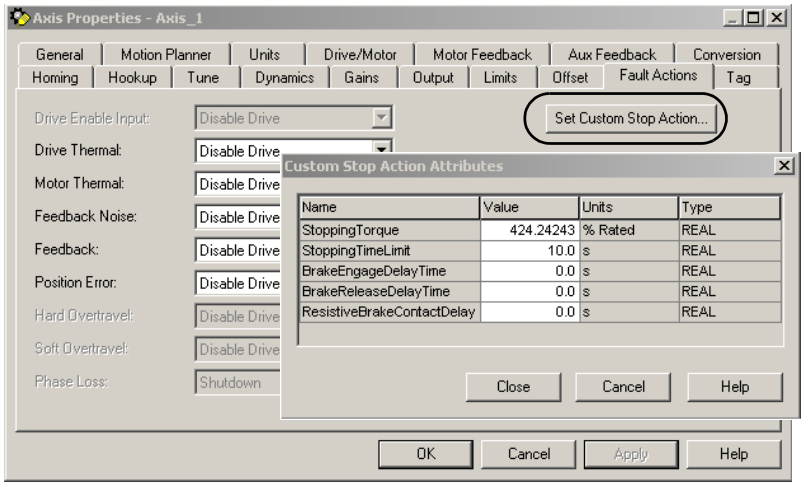
   TIP The drive-enable input signal is located on the IPIM module.

3. Click Apply.
4. Click the Units tab and edit default values as appropriate for your application.
5. Click the Conversion tab and edit default values as appropriate for your application.



6. From the Positioning Mode pull-down menu and choose Rotary.
7. Click Apply.

8. Click the Fault Actions tab.



9. Click Set Custom Stop Action.

   The Custom Stop Action Attributes dialog box opens and lets you set delay times for IDM units.

10. Configure the delay times.
    a. Type the Brake Engage Delay Time.
    b. Type the Brake Release Delay Time.

Cat. No.	Brake Engage Delay ms	Brake Release Delay ms
MDF-SB1003	20	50
MDF-SB1153	25	110
MDF-SB1304		

    c. Click Close.

11. Click OK.
12. Repeat step 1 through step 11 for each IDM unit.
13. Verify your Logix program and save the file.

Download the Program

After completing the Logix configuration you must download your program to the Logix processor.

Apply Power to the System

This procedure assumes that you have wired and configured your Kinetix drive system (with or without the LIM module) and your sercos interface module.

ATTENTION: Capacitors on the DC bus may retain hazardous voltages after input power has been removed. Before working on the IPIM module or disconnecting/connecting any IDM unit, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

Refer to the Chapter 4 for connector locations and Chapter 7 when troubleshooting the IPIM module and IDM unit status indicators.

Follow these steps to apply power to the Kinetix 6000M system.

1. Disconnect the load to the IDM units.

   ATTENTION: To avoid personal injury or damage to equipment, disconnect the load to the IDM units. Make sure each IDM unit is free of all linkages when initially applying power to the system.

2. Apply control power and 3-phase power to your Kinetix drive system and observe the status indicators on your Kinetix 6000 or Kinetix 6200 drive modules.

   Refer to the user manual for your Kinetix 6000 or Kinetix 6200 drive system for the proper status indicator response. When the drive system is powered up and has reached sercos phase 4, continue to step 3.

3. Observe the IDM unit drive status indicator and verify with the table below.

Indication	Status	Do This
Alternating green/red	Module is performing self test	Wait for steady green.
Flashing green	Module is in standby mode	Go to Test and Tune the Axes on page 83.
Solid green	Module is operating	
Solid or flashing red	Fault has occurred	Refer to Chapter 7.

4. Verify the Hardware Enable Input signal is at 0 volts.

   The Hardware Enable input for the IDM system is on the IPIM module (see page 41).

5. Remove the Hardware Enable Input connection, if one exists.

6. Observe the three sercos indicators on the Logix sercos module.

Three Sercos Indicators	Status	Do This
Flashing green and red	Establishing communication	Wait for steady green on all three indicators.
Steady green	Communication ready	Go to Test and Tune the Axes on page 83.
Not flashing green and red/ not steady green	Sercos module is faulted	Go to the appropriate Logix manual for specific instructions and troubleshooting.

Test and Tune the Axes

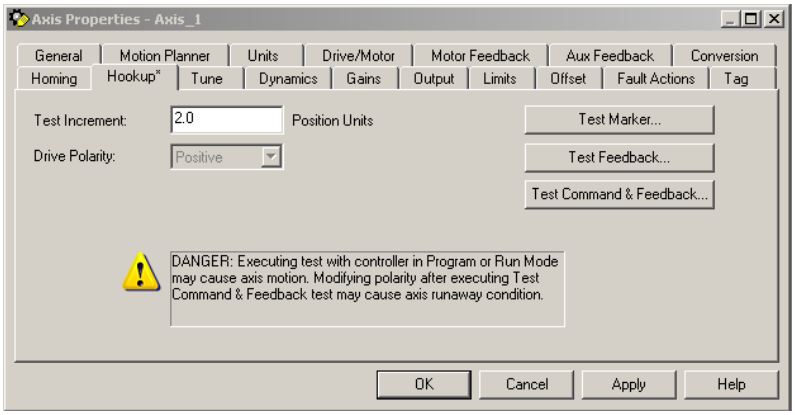
This procedure assumes that you have configured your Kinetix 6000M system, your Logix sercos interface module, and applied power to the system.

For help using RSLogix 5000 software as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix sercos modules, refer to Additional Resources on page 7.

Test the Axes

Follow these steps to test the axes.

1. Verify the load was removed from each axis.
2. Right-click an axis in your Motion Group folder and choose Properties.
   The Axis Properties dialog box opens.



3. Click the Hookup tab.
4. Type 2.0 as the number of revolutions for the test or another number more appropriate for your application.

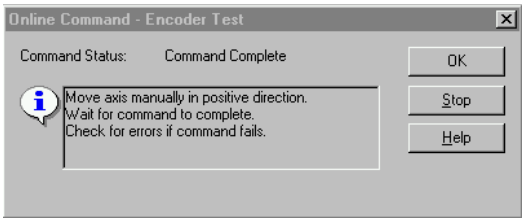
This Test	Performs this Test
Test Marker	Verifies marker detection capability as you rotate the motor shaft.
Test Feedback	Verifies feedback connections are wired correctly as you rotate the motor shaft.
Test Command & Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate.

5. Apply Hardware Enable Input signal for the axis you are testing.

IMPORTANT Hardware Enable input for IDM units is on the IPIM module.

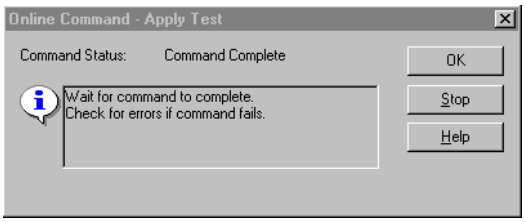
6. Select the desired Test (Marker/Feedback/Command & Feedback) to verify connections.

   The Online Command dialog box opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from Executing to Command Complete.

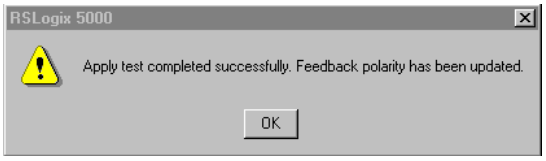
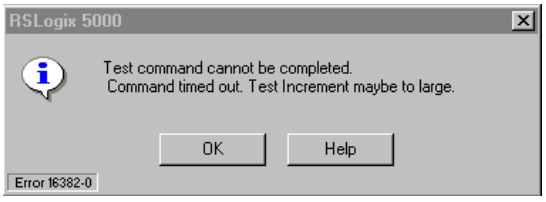


7. Click OK.

   The Online Command - Apply Test dialog box opens (Feedback and Command & Feedback tests only). When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.
9. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog box opens. 	1. Click OK. 2. Remove Hardware Enable Input signal (1). 3. Go to Tune the Axes on page 85.
Your test failed, this dialog box opens. 	1. Click OK. 2. Verify the Bus status indicator turned solid green during the test. 3. Verify that the Hardware Enable Input (1) signal is applied to the axis you are testing. 4. Verify conversion constant entered in the Conversion tab. 5. Return to main step 6 and run the test again.

(1) The hardware enable input for IDM units is on the IPIM module.

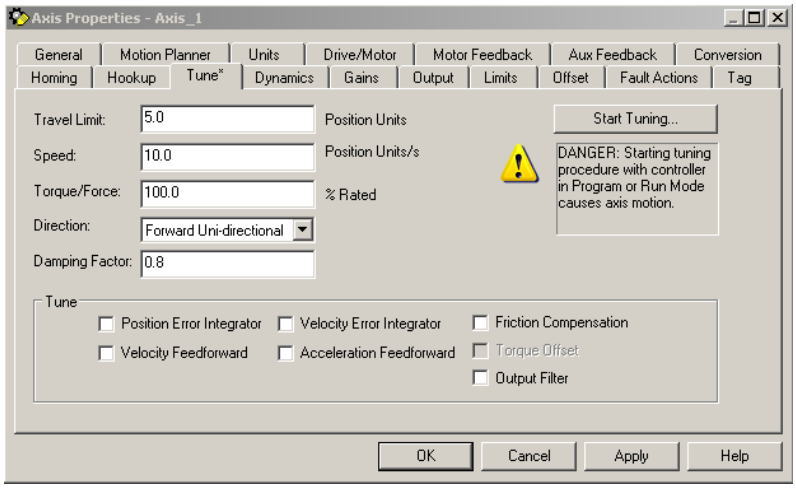
Tune the Axes

Follow these steps to tune the axes.

1. Verify the load is still removed from the axis being tuned.

> **ATTENTION:** To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Tune tab.



3. Type values for Travel Limit and Speed.

   In this example, Travel Limit = 5 and Speed = 10. The actual value of programmed units depend on your application.

4. From the Direction pull-down menu, choose a setting.

   Forward Uni-directional is default.

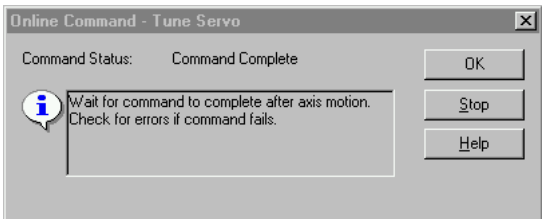
5. Check Tune boxes as appropriate for your application.

6. Apply Hardware Enable Input signal for the axis you are tuning.

> **IMPORTANT** Hardware Enable input for IDM units is on the IPIM module.

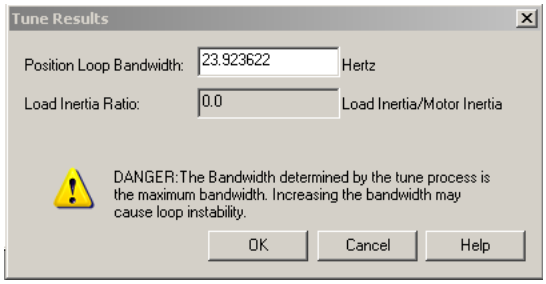
7. Click Start Tuning to auto-tune your axis.

   The Online Command - Tune Servo dialog box opens. When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.

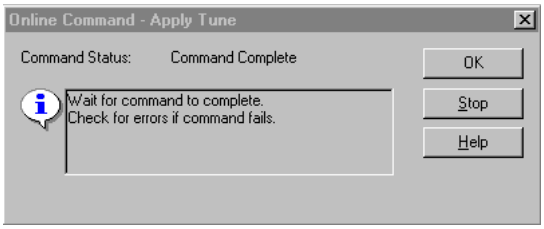
   The Tune Bandwidth dialog box opens.



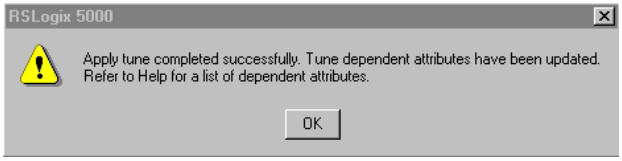
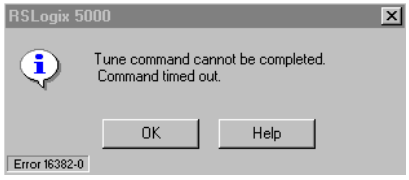
   Actual bandwidth values (Hz) depend on your application and may require adjustment once motor and load are connected.

9. Record your bandwidth data for future reference.
10. Click OK.

    The Online Command - Apply Tune dialog box opens. When the test completes, the Command Status changes from Executing to Command Complete.



11. Click OK.
12. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog box opens. 	1. Click OK. 2. Remove the Hardware Enable Input signal applied earlier (1). 3. Go to step 13.
Your test failed, this dialog box opens. 	1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to the appropriate Logix motion module user manual for more information. 4. Return to step 7 and run the test again.

(1) The hardware enable input for IDM units is on the IPIM module.

13. Repeat Test and Tune the Axes for each axis.

Troubleshooting the Kinetix 6000M System

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Safety Precautions

ATTENTION: Capacitors on the DC bus may retain hazardous voltages after input power has been removed. Before working on the IDM system, measure the DC bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the IPIM module. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Do not attempt to defeat or override the fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.

ATTENTION: Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

IDM System Error Codes

The IAM module reports a single, generic IPIM fault whenever a fault occurs on any IPIM module in the same backplane as the IAM module. All IPIM faults result in an open contactor. The Logix Axis Tag for this fault is IPIMFault.

The IPIM module is not a sercos device, so the IAM module reports any IPIM faults to the Logix motion subsystem. IPIM faults are reset by performing a fault reset on the IAM module. Issuing a fault reset command to the IAM module also generates a fault reset to all the IPIM modules in the same backplane as the IAM. Detailed information about the IPIM fault status may be obtained by messaging to the IAM.

Connecting the IPIM module into the Logix environment as an EtherNet/IP device does not disable fault reporting through the IAM module. Only the IAM fault reporting lets the Logix motion sub-system take action based on the IPIM module fault status. IPIM faults are also reported to Logix over the Ethernet connection. However, IPIM faults must be reset by applying a fault reset instruction to the IAM module. The integration of the IPIM module into the Logix environment through the EtherNet/IP network provides additional capabilities you may choose to take advantage of in your Logix program.

Reading the Fault Status of the IPIM Module

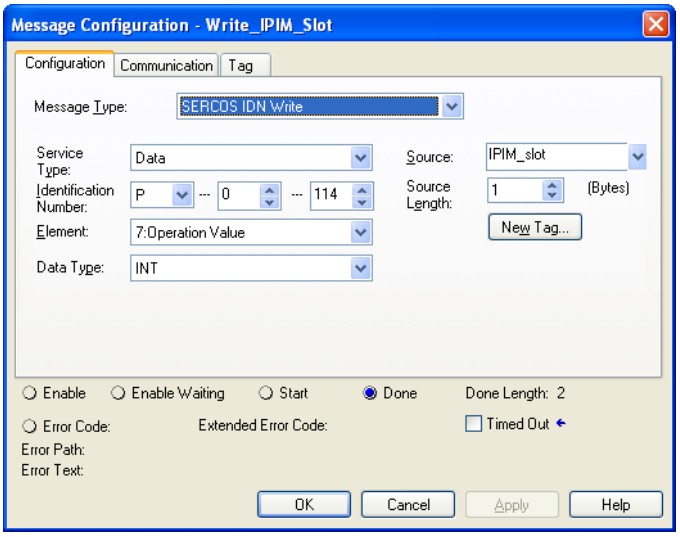
The IAM module supports two IDNs to allow reading the fault status from the IPIM, P-0-113 and P-0-114. Both of these IDNs have a data type of INT. To read the fault status from an IPIM module, first write the slot number of the IPIM module you want to read to IDN P-0-114. The left-most slot (the slot occupied by the IAM module) is slot 1, and the slot numbers increment as you move to the right. After the slot number has been written, the IPIM module fault status can be obtained by reading IDN P-0-113. The 16-bit value returned is a bitfield representing the state of the IPIM faults, as follows:

- Value: IPIM diagnostics: (1 = active, 0 = inactive)
- Bit 0: Backplane Communication error
- Bit 1: IDM Communication error
- Bit 2: Bus Overload (excessive current usage by IDMs)
- Bit 3: DC+ Fuse open
- Bit 4: DC- Fuse open
- Bit 5: Control Power Overload
- Bit 6: DC Bus Overcurrent Error (instantaneous overcurrent)
- Bit 7: Shunt Overload
- Bit 8: Overtemp Error
- Bit 9: Open DC Bus Error
- Bits 10-15: Reserved/Not Used

Setting the Message Configuration Parameters

Set the write message configuration parameters as shown in Figure 34.

Figure 34 - Message Configuration - Write



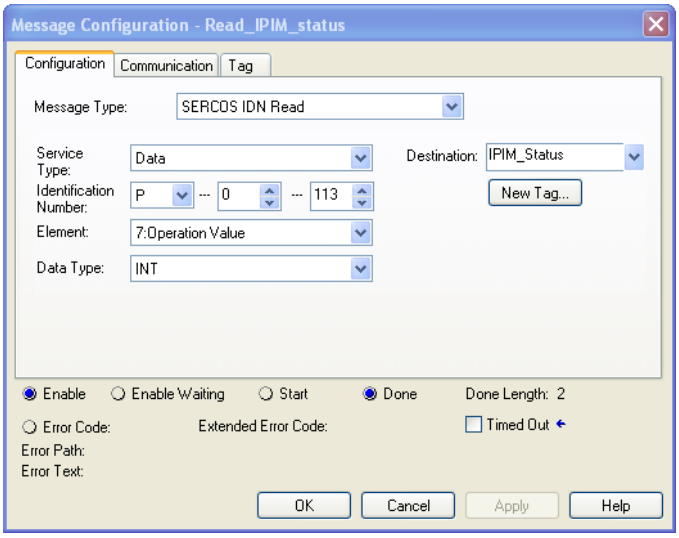
1. Set the Source field to a tag that contains the slot location for the IPIM module.

   The slot location valid range is 2 - 8, (assuming an 8 slot power rail). The IAM module is always in slot 1.

2. Set the path field on the communication tab to the IAM module on the power rail where the IPIM module is located.

Set the read message configuration parameters as shown Figure 35.

Figure 35 - Message Configuration - Read



1. Set the Source field to a tag where the IPIM module status will be stored.
2. Set the path field on the communication tab to the IAM module on the power rail where the IPIM module is located.

Refer to the user manual for your Kinetix 6000 or Kinetix 6200 drive system for further information on reading and writing IDNs.

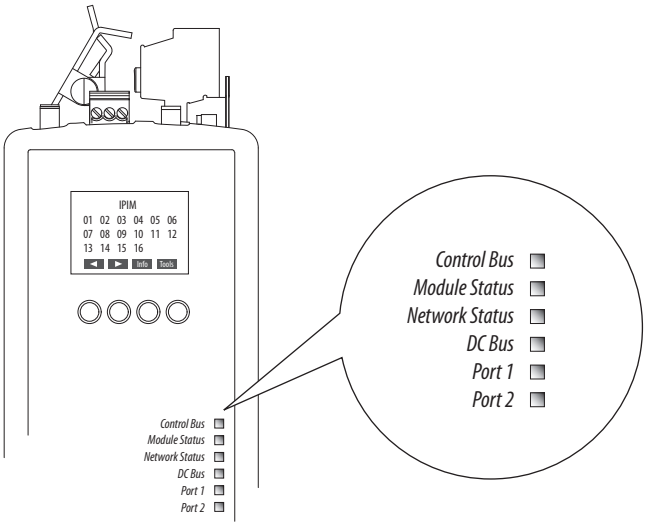
Interpret Status Indicators

When a fault condition is detected, the appropriate status indicator will illuminate (IDM unit or IPIM module) and the IPIM module will annunciate the fault on its front panel display. Refer to Figure 36 for IPIM status indicator descriptions and Figure 37 for IDM unit indicators.

IPIM Module Status Indicators

IPIM module fault descriptions, types and actions start on page 94.

Figure 36 - IPIM Display and Status Indicators



Indicator		Indication	Description
Control Bus	Status of the Control Bus	Off	Control bus is not present
		Solid Green	Control bus is present
		Solid Red	A fault has occurred
Module Status	IPIM Module Status	Off	Power is not applied to the module
		Flashing Green	Module is in Standby mode - configuration may be required
		Solid Green	Module is operating correctly
		Flashing Red	A recoverable fault has occurred (1)
		Solid Red	An unrecoverable fault has occurred (1)
		Alternating Green/Red	Self-test mode during powerup
Network Status	Network Status	Off	Not powered or no IP address
		Flashing Green	No connections, but an IP address has been obtained
		Solid Green	An established connection exists
		Flashing Red	A connection has timed out
		Solid Red	Duplicate IP is present
		Alternating Green/Red	Self-test mode during powerup
DC Bus	Status of the DC Bus	Off	DC Bus is not present
		Flashing Green	DC bus is present and all IDM units are disabled
		Solid Green	DC bus is present and at least one IDM unit is enabled

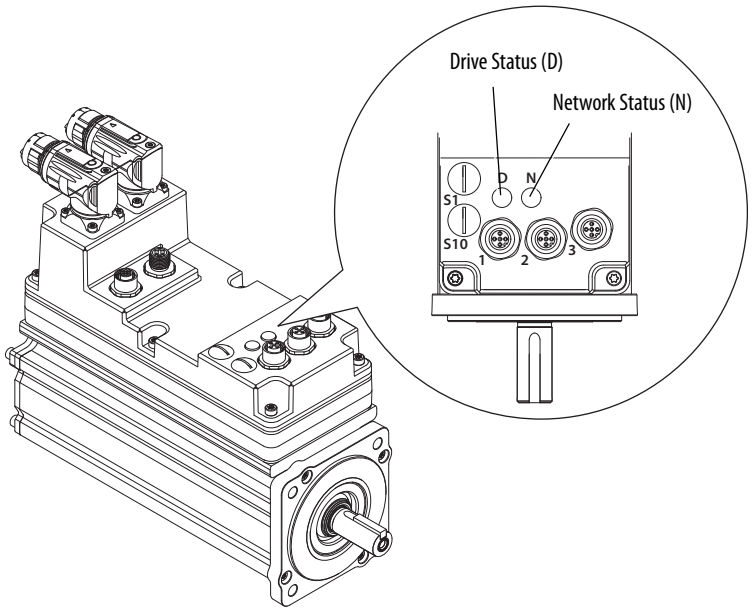
Indicator		Indication	Description
Port 1 Port 2	Status of the EtherNet/IP ports	Off	Port is not connected
		Flashing Green	Port is connected and communication is occurring
		Solid Green	Port is connected, but no communication is not occurring

(1) A reset or cycling the power may clear a recoverable fault (depending on the state of the IDM). An unrecoverable fault will require power cycling and/or modifying the hardware configuration while unpowered to clear the fault.

IDM Unit Status Indicators

IDM unit fault descriptions and actions start on page 95.

Figure 37 - IDM Unit Indicators



Indicator		Indication	Description
Network Status (N)	Provides communication status for the IDM unit.	Off	Communication is not active
		Flashing green (1 s interval)	Communication is being established
		Solid green	Communication has been established
		Solid red	A duplicate address exists
		Fast flashing green (0.5 s interval)	Firmware update in process
		Slow flashing green (2 s interval)	Firmware update in process on another IDM
Drive Status (D)	Provides general status for the IDM unit.	Off	Power is not applied
		Flashing green	Module is in standby mode
		Solid green	Module is operating
		Flashing red	Recoverable fault has occurred (1)
		Solid red	Unrecoverable (or hardware) fault has occurred (1)

(1) A reset or cycling the power may clear a recoverable fault (depending on the state of the IDM). An unrecoverable fault will require power cycling and/or modifying the hardware configuration while unpowered to clear the fault.

General System Anomalies

These anomalies do not always result in a fault code, but may require troubleshooting to improve performance.

Condition	Potential Cause	Possible Solution
Axis or system is unstable.	Unintentionally in Torque mode.	Check to see what primary operation mode was programmed.
	IDM unit tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in RSLogix 5000 software.
	Mechanical resonance.	Notch filter or output filter may be required (refer to Axis Properties dialog box, Output tab in RSLogix 5000 software).
You cannot obtain the acceleration/ deceleration that you want.	Torque Limit limits are set too low.	Verify that current limits are set properly.
	The system inertia is excessive.	• Check IDM unit size versus application need. • Review servo system sizing.
	The system friction torque is excessive.	Check IDM unit size versus application need.
	Available current is insufficient to supply the correct accel/decel rate.	• Check IDM size versus application need. • Review servo system sizing.
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.
IDM unit does not respond to a velocity command.	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	The IDM wiring is open.	Replace the IDM unit.
	The IDM thermal switch has tripped.	• Check for a fault. • Check the wiring.
	The IDM unit has malfunctioned.	Replace the IDM unit.
	The coupling between IDM unit and machine has broken (for example, the IDM unit moves, but the load/machine does not).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the limit.
	Velocity or current limits are set incorrectly.	Check and properly set the limits.
Presence of noise on wires/cables.	Recommended grounding per installation instructions have not been followed.	• Verify grounding. • Route wire away from noise sources. • Refer to System Design for Control of Electrical Noise, publication GMC-RM001.
	Line frequency may be present.	• Verify grounding. • Route wire away from noise sources.
Sercos ring not phasing up.	Duplicate node settings.	Change the node address.
	Incompatible data rates.	Verify that the data rate is set to 8 Mbps for all Kinetix 6000 modules.

Condition	Potential Cause	Possible Solution
No rotation	The IDM unit connections are loose or open.	Check IDM unit wiring and connections.
	Foreign matter is lodged in the IDM unit.	Remove foreign matter.
	The IDM unit load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the IDM unit for repair.
	The IDM unit brake is engaged (if supplied).	• Check brake wiring and function. • Return the IDM unit for repair.
	The IDM unit is not connect to the load.	Check coupling.
IDM unit overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive IDM unit current.	Return the IDM unit for repair.
Abnormal noise	IDM unit tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Loose parts are present in the IDM unit.	• Remove the loose parts. • Return IDM unit for repair. • Replace IDM unit.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return IDM unit for repair.
	Mechanical resonance.	Notch filter may be required (refer to Axis Properties dialog box, Output tab in RSLogix 5000 software).

IPIM Module Fault Diagnosis

When a fault condition is detected, it is added to a fault log, opens the power rail SYSOK and reports the fault to the IAM module. This causes a loss of bus power to all modules on the Bulletin 2094 power rail and associated IDM units. If an IPIM module fault is detected, the fault will be displayed on the IPIM module. In addition, the IPIM module will display IDM unit faults.

The IAM module generates a fault whenever an IPIM module fault occurs, regardless of the state of the contactor. IDM unit faults are not displayed by the IAM module.

Issuing a fault reset command to the IAM module will also send a fault reset command to the IPIM module.

The IPIM module maintains a log of the last 50 faults reported by the IPIM module or any of the connected IDM units. Each fault contains the source of the fault (IDM unit number or IPIM module), the fault number, and a timestamp with the cumulative power-on time of the IPIM module.

IPIM Module Fault Types

The IPIM has two fault types: resettable and non-resettable.

When an IPIM module fault occurs, the fault is reported to the IAM module. The IAM module reports an IPIM fault to the Logix controller.

Resettable faults - when the IPIM module fault is cleared from the IAM module, the fault is removed from its display (if the condition has been removed).

Non-resettable faults - the control power must be cycled and the fault may be cleared if the condition that created the fault has been removed.

Table 19 - IPIM Fault Types, Descriptions and Actions

Fault	Type	Description	Potential Cause	Possible Solution
IPIM FLT 01	Resettable	Backplane Comm	Lost backplane communication with IAM module.	Verify control power to IAM module.
IPIM FLT 02	Resettable	IDM Comm	Lost communication with IDM unit.	Verify control power to IDM units.
IPIM FLT 03	Resettable	DC Bus Overload	Excessive RMS current usage by IDM units.	Reduce the amount of current required by the IDM units or add an additional IPIM module to the Kinetix 6000 rail.
IPIM FLT 04	Resettable	DC+ Fuse Blown	Wiring error or DC bus short.	Check wiring and IDM units for DC bus integrity. Once the wiring issue or damaged IDM unit has been removed and replaced, change the DC+ fuse.
IPIM FLT 05	Resettable	DC- Fuse Blown	Wiring error or DC bus short.	Check wiring and IDM units for DC bus integrity. Once the wiring issue or damaged IDM unit has been removed and replaced, change the DC- fuse.
IPIM FLT 06	Not Resettable	Control Power Overcurrent	Excessive control power usage by the IDM units.	Check for control power wiring shorts. Reduce number of ID units. Reduce the number of power cycles.
IPIM FLT 07	Resettable	DC Bus Overcurrent	Excessive instantaneous current usage by IDM units.	Reduce number of IDM units per IPIM module or modify motion profiles to reduce current draw.
IPIM FLT 08	Resettable	Bus Regulator Thermal Overload	Thermal model of IPIM shunt indicates overheating due to excessive current regeneration.	Modify the IDM unit or Kinetix 6000 motion profiles and/or applications to reduce the regenerative energy. Add external shunt modules.
IPIM FLT 09	Resettable	Overtemp	Excessive temperature measured in the IPIM module.	Verify ambient operating conditions. Replace the IPIM module.
IPIM FLT 10	Resettable	Open DC Bus	IDM unit hybrid cable disconnected.	Check hybrid cable connections at the IPIM module and each IDM unit.
IPIM FLT 11	Not Resettable	Runtime Error	Unexpected firmware error.	Reboot.
–	Not Resettable	Display is blank and Module Status is Solid Red	Corrupted Main Firmware.	Replace IPIM module.

Table 20 - IPIM Initialization Fault Types, Descriptions and Actions

Fault	Type	Description	Potential Cause	Possible Solution
IPIM INIT FLT 03	Resettable	IAM Version	IAM module firmware version does not support IPIM modules.	Update IAM module firmware.
IPIM INIT FLT 05	Not Resettable	Custom Logic Watchdog	Main firmware has lost communication.	Cycle power on the IPIM module. Check for firmware updates. Contact Allen-Bradley Technical Support.

IDM Unit Fault Diagnosis

Logix Controller/IDM Unit Fault Behavior

These RSLogix 5000 fault actions are configurable from the Axis Properties dialog box, Fault Actions tab.

Table 21 - Fault Action Definitions

Fault Action	Definition
Shutdown	Axis is disabled as defined in Table 22. In addition, the axis in Logix enters the Shutdown state, which disables any axes that are using this axis as a camming or gearing master. The AxisHomedStatus tag for the faulted axis is cleared. Shutdown is the most severe action to a fault and it is usually reserved for faults that could endanger the machine or operator if power is not removed as quickly as possible.
Disable Drive	The axis is disabled as defined in the Table 22.
Stop Motion	The axis decelerates at the maximum deceleration rate (set in RSLogix 5000 software>Axis Properties>Dynamics tab). Once the axis has come to a stop, the servo loops remain enabled but no further motion can be generated until the fault is reset. This is the gentlest stopping mechanism in response to a fault. It is usually used for less severe faults.
Status Only	System continues to operate. Status is displayed on the IPIM module.

Only selected faults are programmable. Table 22 indicates which faults have a programmable RSLogix Fault Action. Faults that do not have a programmable fault action will have the Shutdown action described in Table 21.

Figure 38 - RSLogix 5000 Axis Properties - Fault Actions Tab

Drive Fault Action/Attribute for IDM Overtemp fault (E04).

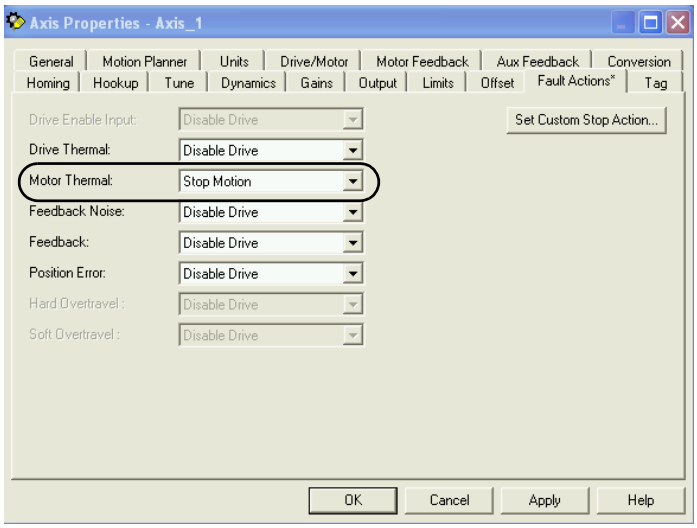


Table 22 - Exception/Fault Behavior

IPIM Display (RSLogix Drive Fault)	IDM Status Indicator	Potential Cause	Possible Solution	RSLogix Programmable Fault Action	Fault Behavior
E04 – Motor Overtemp (MotorOvertempFault)	Flashing Red	Excessive IDM unit temperature.	• Lower ambient temperature, increase IDM unit cooling.	Yes	Decel/Disable
E05 – Power Fault (DriveOvercurrentFault)	Flashing Red	Operation above the IGBT instantaneous current rating or IPIM module power supply undervoltage.	• Operate within the instantaneous power rating. • Reduce acceleration rates. • If fault persists, replace IDM unit.	No	Coast/Disable/ Open Contactor Enable

Table 22 - Exception/Fault Behavior (continued)

IPIM Display (RSLogix Drive Fault)	IDM Status Indicator	Potential Cause	Possible Solution	RSLogix Programmable Fault Action	Fault Behavior
E06 – Positive/Negative Hard Overtravel (Pos/NegHardOvertravelFault)	Flashing Red	Axis moved beyond the physical travel limits in the positive/negative direction.	• Verify motion profile. • Verify axis configuration in software.	Yes	Decel/Disable
E09 – Bus Under Voltage (DriveUndervoltageFault)	Flashing Red	DC bus voltage fell below the undervoltage limit while the axis was enabled.	• Disable prior to removing power. • Check wiring.	No	Coast/Disable/ Open Contactor Enable
E10 – Bus Over Voltage (DriveOvervoltageFault)	Flashing Red	The DC bus voltage is above limits.	• Change the deceleration or motion profile. • Use a larger IDM unit. • Install shunt module.	No	Coast/Disable/ Open Contactor Enable
E16 – Positive/Negative Soft Overtravel (Pos/NegSoftOvertravelFault)	Flashing Red	Positive/Negative software overtravel limit exceeded.	• Verify motion profile. • Verify overtravel settings are appropriate.	Yes	Decel/Disable
E18 – Over Speed (OverspeedFault)	Flashing Red	Excessive IDM unit speed.	• Check tuning. • Verify user limit.	No	Coast/Disable
E19 – Follow Error (PositionErrorFault)	Flashing Red	Excessive position error.	• Increase the feed forward gain. • Increase following error limit or time. • Check position loop tuning. • Verify sizing of system. • Verify mechanical integrity of system within specification limits.	Yes	Coast/Disable
E30 – Motor Feedback Comm (MotFeedbackFault)	Flashing Red	Error communicating with position feedback device.	• Cycle power. • If fault persists, replace IDM unit.	No	Decel/Disable
E37 – Phase Loss (PowerPhaseLossFault)	Flashing Red	Problem with the AC power connection on IAM module.	• Check IAM input AC voltage on all phases. • Disable the IDM unit before removing power.	No	Decel/Disable
E38 – Sercos Ring Flt (SercosFault)	Flashing Red	Lost sercos communications.	• Check that sercos cable is present and connected properly.	No	Decel/Disable
E43 – Drive Enable Flt (DriveEnableInputFault)	Flashing Red	Missing IPIM module Enable input signal.	• Disable the IPIM module Enable hardware input fault. • Verify that IPIM module Enable hardware input is active whenever the IPIM module is enabled.	Yes	Decel/Disable
E48 – Internal Communications Fault (DriveHardFault)	Solid Red	Noise or hardware failure on the I2C or SPI bus.	• Power Cycle. • If fault persists, replace IDM unit.	No	Coast/Disable/ Open Contactor Enable
E49 – Safety Fault (DriveHardFault)	Flashing Red	Safe-off input timing mismatch.	• Verify wire terminations, cable/header connections, and +24V. • Reset error and run proof test. • If fault persists, replace module.	No	Coast/Disable/ Open Contactor Enable
E50 – Sercos Same Addr (SercosRingFault)	Solid Red	Duplicate node address detected on sercos ring.	• Verify that each sercos module is assigned a unique node address.	No	Decel/Disable
E54 – Current Feedback Hardware Fault (DriveHardFault)	Solid Red	Excessive feedback current was detected.	• Power Cycle. • If fault persists, replace IDM unit.	No	Coast/Disable/ Open Contactor Enable
E65 – Hookup (DriveHardFault)	Flashing Red	Hookup procedure failed.	• Check IDM unit power/feedback wiring. • Refer to RSLogix 5000 on-screen message for resolution.	No	Coast/Disable

Table 22 - Exception/Fault Behavior (continued)

IPIM Display (RSLogix Drive Fault)	IDM Status Indicator	Potential Cause	Possible Solution	RSLogix Programmable Fault Action	Fault Behavior
E66 – Autotune (DriveHardFault)	Flashing Red	Autotune procedure failed.	• Check IDM unit power/feedback wiring. • Refer to RSLogix 5000 on-screen message for resolution. • Perform Hookup Test in RSLogix 5000 software. • Consult RSLogix 5000 help screen.	No	Coast/Disable
E67 – Task Init (DriveHardFault)	Solid Red	Operating system failed.	• Cycle power. • If fault persists, replace module.	No	Coast/Disable/ Open Contactor Enable
E69 – Objects Init (DriveHardFault)	Solid Red	Non-volatile memory is corrupt due to control board hardware failure.	• Load default parameters, save to non-volatile memory, and recycle power or reset the IPIM module.	No	Coast/Disable/ Open Contactor Enable
E70 – NV Mem Init (DriveHardFault)	Solid Red	Non-volatile memory is corrupt due to control board software error.	• Load default parameters, save to non-volatile memory, and recycle power or reset the IPIM module.	No	Coast/Disable/ Open Contactor Enable
E71 – Memory Init (DriveHardFault)	Solid Red	RAM or Flash memory validation failure.	• Cycle power. • If fault persists, replace module.	No	Coast/Disable/ Open Contactor Enable
E72 – Drive Overtemperature (DriveOvertempFault)	Flashing Red	Excessive heat in the circuitry.	• Replace the failed module. • Check the ambient temperature. • Change the command profile to reduce speed or increase time. • Check the mounting clearance.	Yes	Decel/Disable
E76 – CAN Init (DriveHardFault)	Solid Red	CAN hardware initialization fault detected.	• Reset System. • If fault persists, replace system module.	No	Coast/Disable/ Open Contactor Enable
E78 – Sercos Init (DriveHardFault)	Solid Red	Sercos hardware fault detected.	• Cycle power. • If fault persists, replace module.	No	Coast/Disable/ Open Contactor Enable
E109 – IGBT Over-temperature (DriveOvertempFault)	Flashing Red	Excessive IGBT temperature.	• Lower ambient temperature. • Reduce motion profile.	No	Coast/Disable/ Open Contactor Enable

Use a Web Browser to Monitor System Status

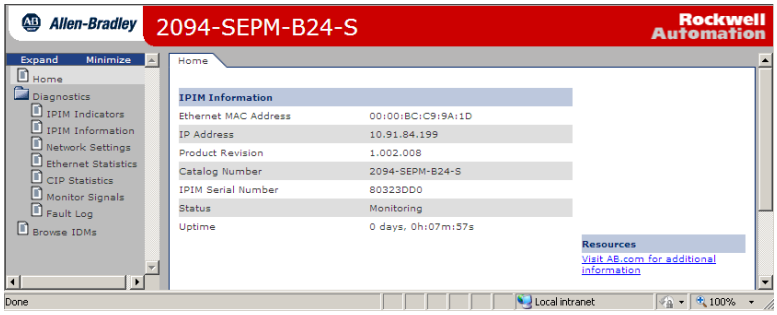
The IPIM module supports a basic web interface for common status reporting and network configuration attributes, including:

- Diagnostics
- IPIM Indicators
- IPIM Information
- Network Settings
- Ethernet Statistics
- CIP Statistics
- Monitor Signals
- Fault Log
- Browse IDMs
- IDM Indicators
- Monitor IDM Signals

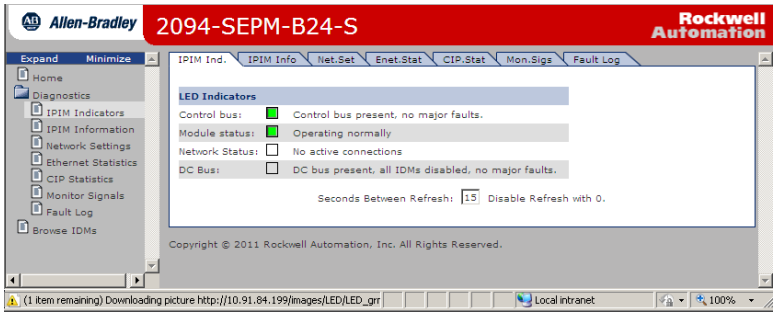
To access the web interface:

1. Using an Ethernet cable, connect your computer to one of the Ethernet ports on the IPIM module (refer to Figure 11 on page 38 for location).
2. Open a web browser program(1) and enter the IP address of the IPIM module.

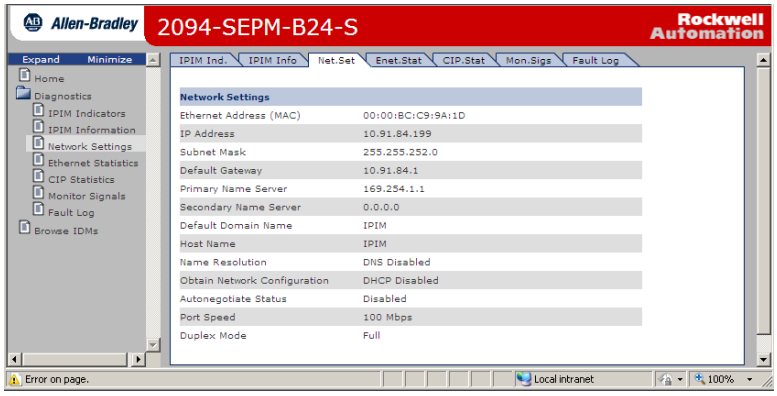
   The Home screen will be displayed.



3. Selecting IPIM Indicators provides indicator status.



4. Network settings displays a summary of the various parameters.



(1) Internet Explorer version 6.0 (or greater) or Mozilla Firefox version 4.0 (or greater) is required.

Removing and Replacing the Kinetix 6000M IPIM Module

This chapter provides removal and replacement procedures for your Kinetix 6000M IPIM module.

Refer to your Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, or Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, for other replacement procedures.

Topic	Page
Before You Begin	99
Remove the IPIM Module	100
Replace the IPIM Module	101

ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Guarding Against Electrostatic Damage, publication 8000-4.5.2, or any other applicable ESD awareness handbook.

Before You Begin

You will need these tools available before you begin removal and replacement procedures:

- A small screwdriver, 3.5 mm (0.14 in.)
- Voltmeter

Remove the IPIM Module

Follow these steps to remove your IPIM module from the Bulletin 2094 power rail.

1. Verify that all control and input power has been removed from the system.

> **ATTENTION:** To avoid shock hazard or personal injury, assure that all power has been removed before proceeding. This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system.

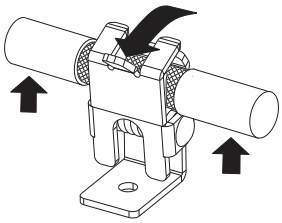
2. Wait five minutes for the DC bus to discharge completely before proceeding.

> **ATTENTION:** This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. You should attempt the procedures in this document only if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

3. Label and remove all connectors from the IPIM module you are removing.

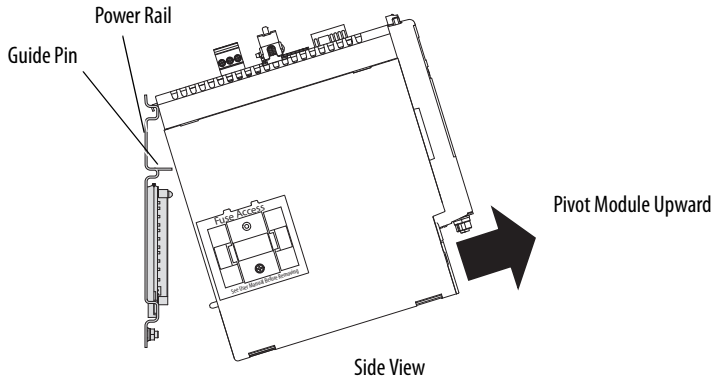
   To identify each connector, refer to page 38.

4. Remove the hybrid cable from the cable shield clamp, as shown.



5. Loosen the mounting screw (bottom center of module).
6. Grasp the top and bottom of the module with both hands and gently pull the module away from the connectors enough to clear the guide pins (module will pivot on top bracket).

7. Lift the bracket out of the power rail slot and remove the module from the power rail.



Replace the IPIM Module

Follow these steps to replace the IPIM module on the Bulletin 2094 power rail.

1. Inspect the module connector pins and power rail connectors and remove any foreign objects.
2. Hang the module mounting bracket from the slot on the power rail.

IMPORTANT	Power rails must be in vertical orientation before replacing drive modules or pins may not seat properly.

3. Pivot module downward and align the guide pin on the power rail with the guide pin hole in the back of the module (refer to the figure above).
4. Gently push the module against the power rail connectors and into the final mounting position.
5. Use 2.26 N•m (20 lb•in) torque to tighten the mounting screw.
6. Reconnect the module connectors.
7. Reapply power to the system.
8. Verify that the system is operating properly.

Notes:

Using the Safe Torque-off Feature with the Kinetix 6000M System

This appendix introduces you to how the safe torque-off feature meets the requirements of Performance Level d (PLd) and Category 3 (Cat3) per EN ISO 13849-1 and SIL CL 2 per IEC EN 61508, EN 61800-5-2 and EN 62061.

Topic	Page
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Description of Operation	104
PFD, PFH, and MTTFd Definitions	107
PFD, PFH, and MTTFd Data	107
Wiring Your Safe Torque-off Circuit	107
IDM Safe Torque-off Feature	108
IDM System Safe Torque-off Example	109
Cascading the Safe Torque-off Signal	110
Safe Torque-off Signal Specifications	111

Certification

The TÜV Rheinland group has approved the Kinetix 6000M integrated drive-motor system for use in safety-related applications up to EN ISO 13849-1 performance level d (PLd) and category 3, SIL CL 2 per IEC EN 61508, EN 61800-5-2 and EN 62061, in which removing the motion producing power is considered to be the safe state.

Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired EN ISO 13849-1 performance level or EN 62061 SIL level
- Project management and proof testing

Category 3 Requirements According to EN ISO 13849-1

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function
- A single fault is detected whenever reasonably practicable
- Accumulation of undetected faults can lead to the loss of the safety function, which results in failure to remove motion producing power from the motor.

Stop Category Definition

Stop category 0 as defined in EN 60204 or Safe Torque Off as defined by EN 61800-5-2 is achieved with immediate removal of motion producing power to the actuator.

IMPORTANT In the event of a malfunction, the most likely stop category is category 0. When designing the machine application, timing and distance should be considered for a coast to stop. For more information regarding stop categories, refer to EN 60204-1.

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849-1, and SIL levels, according to EN 61508 and EN 62061, include a rating of the systems ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the EN ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

Description of Operation

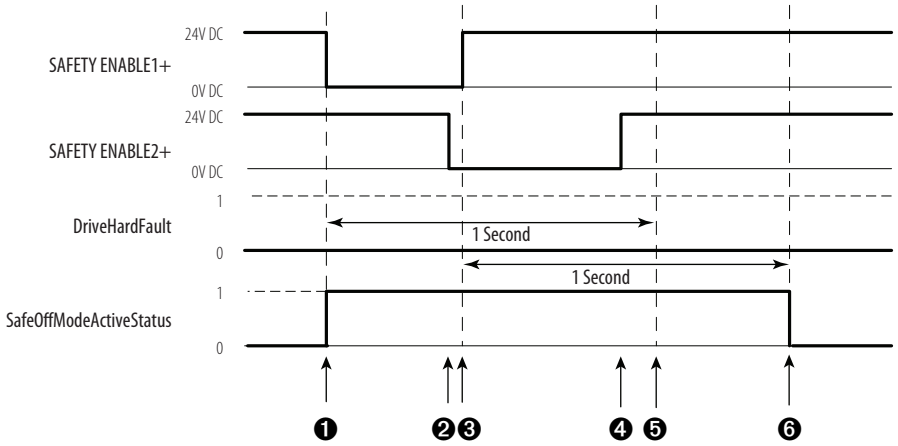
The safe torque-off feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When disabled, or any time power is removed from the safety enable inputs, all of the IDM output-power transistors are released from the On-state. This effectively removes power generated by each IDM unit connected to a single IPIM module and utilizing connections to an external safety device (E-stop, light curtains, etc.). This results in a condition where the IDM unit is coasting (stop category 0). Disabling the power transistor output does not provide mechanical isolation of the electrical output, which may be required for some applications.

Under normal operation, the safe torque-off inputs are energized. If either of the safety enable inputs are de-energized, then all of the output power transistors will turn off. The safe torque-off response time is less then 12 ms.

ATTENTION: Permanent magnet motors may, in the event of two simultaneous faults in the IGBT circuit, result in a rotation of up to 180 electrical degrees.

ATTENTION: If any of the safety enable inputs de-energize, then the SafeOffModeActiveStatus bit of the drive status word in the Axis Tag structure will be set to 1. It will reset to 0 when both safety enable inputs are energized within 1 second (see Figure 39). The safety fault occurs after 1 second.

Figure 39 - System Operation when Inputs are Meeting Timing Requirements



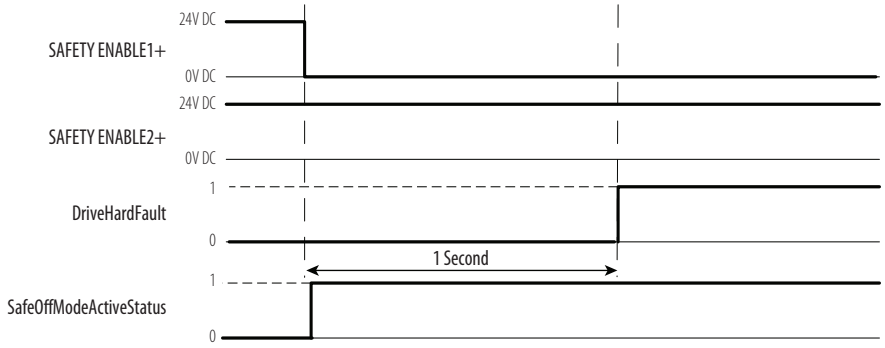
Item	Description
❶	At least one input is switched-off. SafeOffModeActiveStatus bit is set to 1.
❷	Second input is switched-off within 1 second.
❸	First input is switched-on.
❹	Second input is switched-on within 1 second of the first input.
❺	Both inputs change state within 1 second, therefore DriveHardFault is not posted.
❻	SafeOffModeActiveStatus bit set back to 0 if events 3 and 4 occur within a 1 second time interval.

Troubleshooting the Safe Torque-off Function

Error Code	Fault Message RSLogix (HIM)	Anomaly	Potential Cause	Possible Resolution
E49	DriveHardFault (safe torque-off HW Flt)	Safe torque-off function mismatch. System will not allow motion. Safe torque-off mismatch is detected when safety inputs are in a different state for more than 1 second.	• Loose wiring at safe torque-off connector. • Miswiring of the safe torque-off connector. • Cable/header not seated properly in safe torque-off connector. • Safe torque-off circuit missing +24V DC.	• Verify wire terminations, cable/ header connections, and +24V. • Reset error and run proof test. • If error persists, return the module to Rockwell Automation.

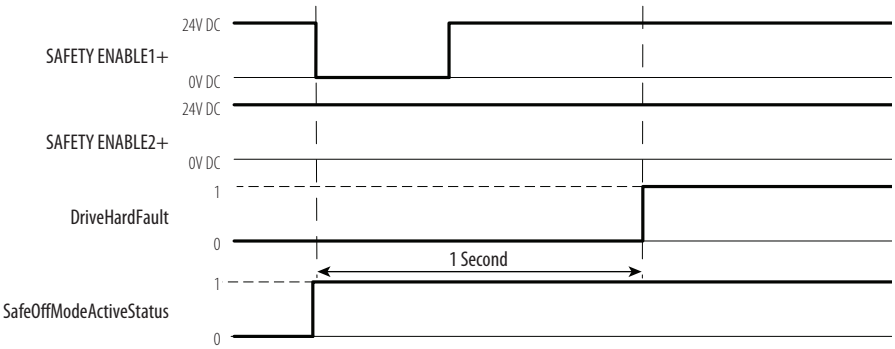
Figure 40 demonstrates when the safe torque-off mismatch is detected and a DriveHardFault is posted.

Figure 40 - System Operation in the Event that the Safety Enable Inputs Mismatch



When one safety input is turned off, the second input must also be turned off, otherwise a fault is asserted (see Figure 41). The fault is asserted even if the first safety input is turned on again.

Figure 41 - System Operation in the Event that the Safety Enable Inputs Mismatch Momentarily



ATTENTION: The safe torque-off fault (E49) is detected upon demand of the safe torque-off function. After troubleshooting, a safety function must be executed to verify correct operation.

IMPORTANT The Safe Torque Off fault (E49) can be reset only if both inputs are in the Off-state for more than 1 second. After the E49 reset requirement is satisfied, an MASR command in RSLogix software should be issued to reset the DriveHardFault.

PFD, PFH, and MTTFd Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode:

- Low Demand mode: where the frequency of demands for operation made on a safety-related system is no greater than one per year or no greater than twice the proof-test frequency.
- High Demand/Continuous mode: where the frequency of demands for operation made on a safety-related system is greater than once per year.

The SIL value for a low demand safety-related system is directly related to order-of-magnitude ranges of its average probability of failure to satisfactorily perform its safety function on demand or, simply, average probability of failure on demand (PFD). The SIL value for a High Demand/Continuous mode safety-related system is directly related to the probability of a dangerous failure occurring per hour (PFH).

PFD, PFH, and MTTFd Data

These PFD and PFH calculations are based on the equations from EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

Determination of safety parameters is based on the assumption that the system operates in high demand mode and that the safety function will be requested at least once a year.

Table 23 - PFD and PFH for 20-year Proof Test Interval

Attribute	Value
PFH (1e-9)	0.35
PFD (1e-3)	0.062
Proof test (years)	20

Wiring Your Safe Torque-off Circuit

Refer to Safe Torque-off Connector on page 40 for wiring details.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IMPORTANT To be sure of system performance, run wires and cables in the wireways as established in the user manual.

IMPORTANT Pins 8 and 9 (24V+) are used only by the motion-allowed jumper. When wiring to the wiring-plug header, **the 24V supply** (for an external safety device that triggers the safe torque-off request) **must come from an external source**, otherwise system performance will be jeopardized.

European Union Directives

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

CE Conformity

Conformity with the Low Voltage Directive and Electromagnetic Compatibility (EMC) Directive is demonstrated by using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The safe torque-off circuit complies with the EN standards when installed according instructions found in this manual.

EMC Directive

This unit is tested to meet Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) by using these standards, in whole or in part:

- EN 61800-3 - Adjustable Speed Electrical Power Drive Systems, Part 3 - EMC Product Standard including specific test methods
- EN 61326-2-1 EMC - Immunity requirements for safety-related systems

The product described in this manual is intended for use in an industrial environment.

CE Declarations of Conformity are available online at http://www.rockwellautomation.com/products/certification/ce.

Low Voltage Directive

These units are tested to meet Council Directive 2006/95/EC Low Voltage Directive. The EN 60204-1 Safety of Machinery-Electrical Equipment of Machines, Part 1-Specification for General Requirements standard applies in whole or in part. Additionally, the standard EN 50178 Electronic Equipment for use in Power Installations apply in whole or in part.

Refer to the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001, for environmental and mechanical specifications.

IDM Safe Torque-off Feature

The safe torque-off circuit, when used with suitable safety components, provides protection according to EN ISO 13849-1 (PLd), Cat3 or according to EN 62061 (SIL2). The safe torque-off option is just one safety control system. All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off circuit is designed to safely turn off all of the output-power transistors.

You can use the safe torque-off circuit in combination with other safety devices to achieve the stop and protection-against-restart as specified in IEC 60204-1.

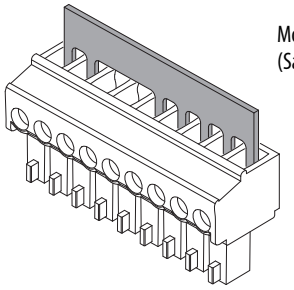
Refer to the Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002, for wiring examples.

ATTENTION: This option may be suitable for performing mechanical work on the drive system or affected area of a machine only. It does not provide electrical safety.

SHOCK HAZARD: In Safe Torque-off mode, hazardous voltages may still be present at the IDM unit. To avoid an electric shock hazard, disconnect power to the system and verify that the voltage is zero before performing any work on the IDM unit.

Safe Torque-off Feature Bypass

Each IPIM module ships with the (9-pin) wiring-plug header and motion-allowed jumper installed in the safe-off connector. With the motion-allowed jumper installed, the safe-off feature is not used.



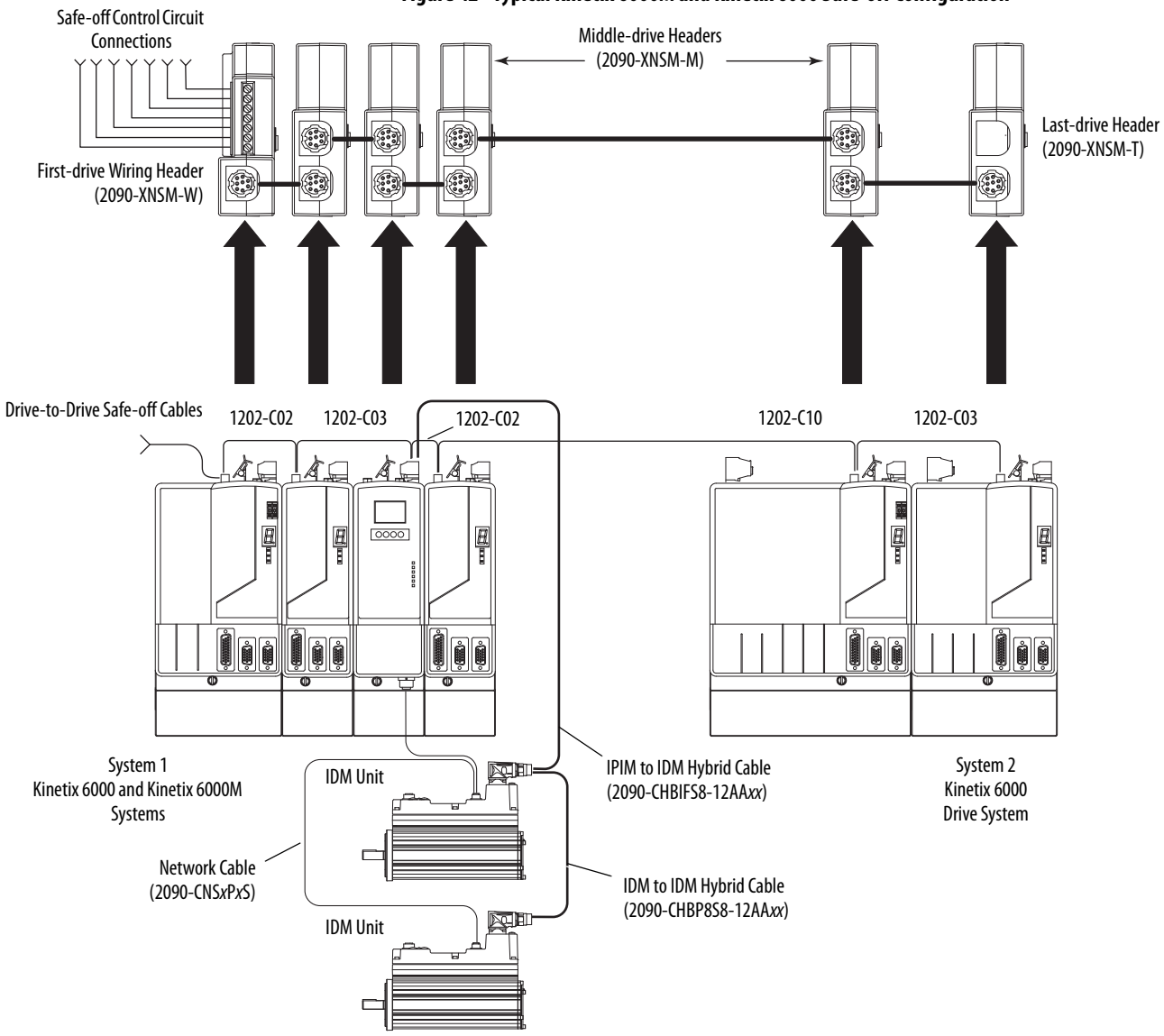
Motion-allowed Jumper Installed
(Safe-off feature bypassed)

IDM System Safe Torque-off Example

Figure 42 shows a typical safe torque-off configuration. Refer to Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002, for further information and wiring diagrams.

For additional information regarding Allen-Bradley safety products, including safety relays, light curtain, and gate interlock applications, refer to the Safety Products Catalog, website http://www.ab.com/catalogs.

Figure 42 - Typical Kinetix 6000M and Kinetix 6000 Safe-off Configuration



Cascading the Safe Torque-off Signal

The total number of IAM, AM, and IPIM modules in a single cascaded safety circuit is limited due to the current carrying capacity of the cascaded safety wiring.

Use the following equation to calculate the number of IDM units that can be added to a cascaded safety chain if Kinetix 6000-S safety accessories are used.

$$\mathbf{m = (16-n) \times 3}$$

where:
m = maximum number of IDM units
n = number of Kinetix 6000-S modules in the safety chain.

EXAMPLE Using Figure 42, n equals 5 since there are 5 Kinetix 6000-S modules in the system. The maximum number of IDM units that can be connected to the cascaded safety circuit through one or more IPIM modules is:
m = (16-5) x 3 = **33**.

Safe Torque-off Signal Specifications

This table provides specifications for the safe torque-off signals used.

Attribute		Value
Safety inputs	Input current	less than10 mA
	Input ON voltage range	18…26.4 V DC
	Maximum input OFF voltage	5V DC
	Input OFF current	2 mA @ Vin less than 5V DC
	Pulse rejection width	700 µs
	External power supply	SELV/PELV
	Input type	Optically isolated and reverse voltage protected

Notes:

Interconnect Diagram

This appendix provides a wiring example for the IDM system.

Topic	Page
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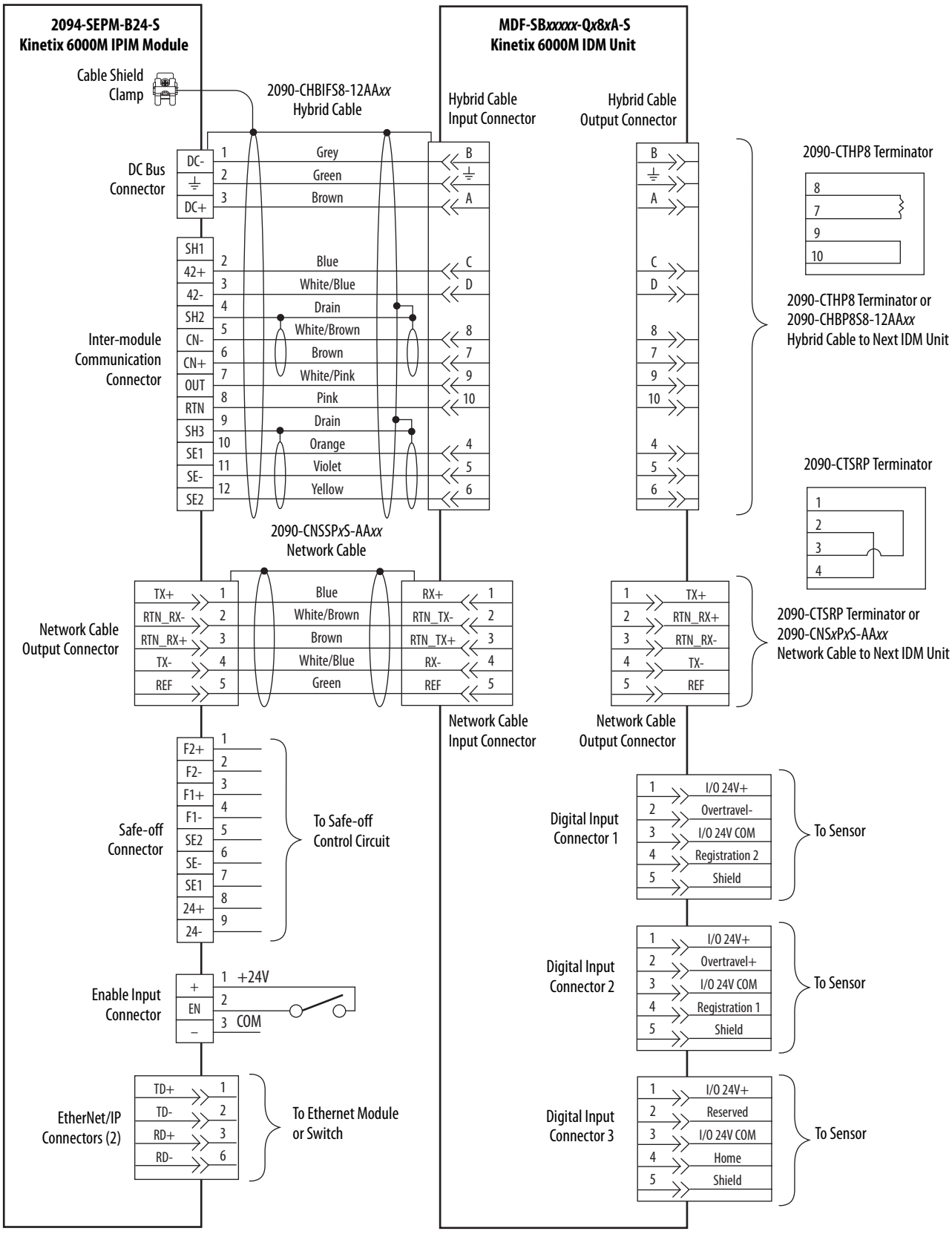
Figure 43 - IPIM Module and IDM Unit Wiring Example



Upgrading the Kinetix 6000M System Firmware

This appendix provides procedures for upgrading firmware for the Kinetix 6000M integrated drive-motor (IDM) units and IDM power interface modules (IPIM).

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IPIM Module Firmware Upgrade	117
IDM Unit Firmware Upgrade	122
Verify the Firmware Upgrade	126

Upgrading firmware for the Kinetix 6000M system is done by using ControlFLASH software. The procedure for upgrading the IDM units uses the sercos interface, similar to axis modules. However, upgrading firmware on the IPIM module is accomplished over the EtherNet/IP network.

Before You Begin

You need the following software and information before you begin.

Description	Cat. No.	Firmware Revision or Software Version
RSLogix 5000 software	9324-RLD300NE	20.01 (2) or later
ControlLogix sercos module	1756-M*xx*SE	20.007 or later
CompactLogix sercos module	1768-M04SE	20.007 or later
SoftLogix sercos PCI card	1784-PM16SE	20.007 or later
RSLinx® software		2.59 or later
ControlFLASH software kit (1)		From website
Catalog number of the targeted IPIM module and IDM unit you want to upgrade		
Network path to the targeted IPIM module and IDM unit.		

(1) Download the ControlFLASH kit from http://support.rockwellautomation.com/controlflash. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.
For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105.

(2) Version 20.00 may be used if the motion database has been updated.

IMPORTANT Control power must be present prior to upgrading your IPIM module or IDM units.

ATTENTION: To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply 3-phase AC or common-bus DC input power to the IAM module.

Configure Logix Communication

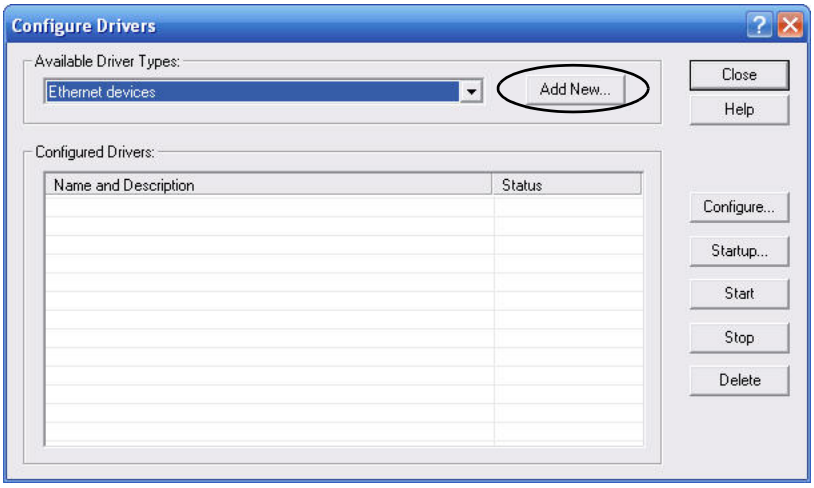
This procedure assumes that your communication method to the Logix controller is using the Ethernet protocol. It is also assumed that your Logix Ethernet module has already been configured.

For more information, refer to the ControlLogix System User Manual, publication 1756-UM001.

Follow these steps to configure Logix communication.

1. Open your RSLinx Classic software.
2. From the Communications pull-down menu, choose Configure Drivers.

   The Configure Drivers dialog box opens.



3. From the Available Drive Types pull-down menu, choose Ethernet devices.
4. Click Add New.

   The Add New RSLinx Classic Driver dialog box opens.

5. Type the new driver name.

6. Click OK.

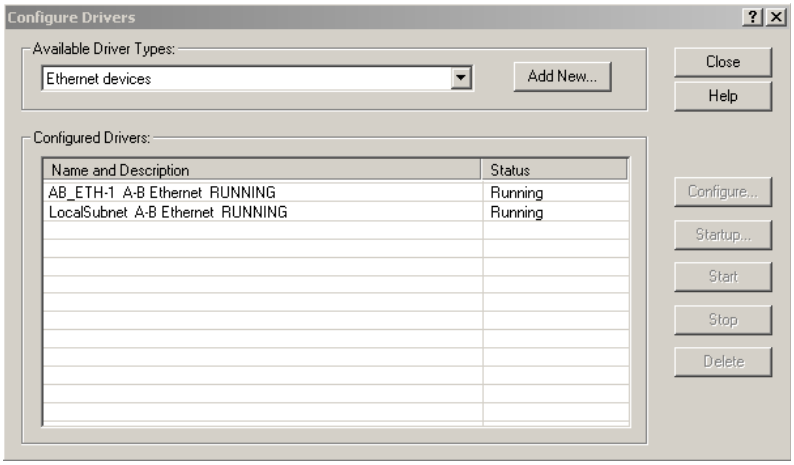
   The Configure driver dialog box opens.

7. Type the IP address of your Logix Ethernet module.

   The IP address shown is an example. Yours will be different.

8. Click OK.

   The new Ethernet driver appears under Configured Drivers.



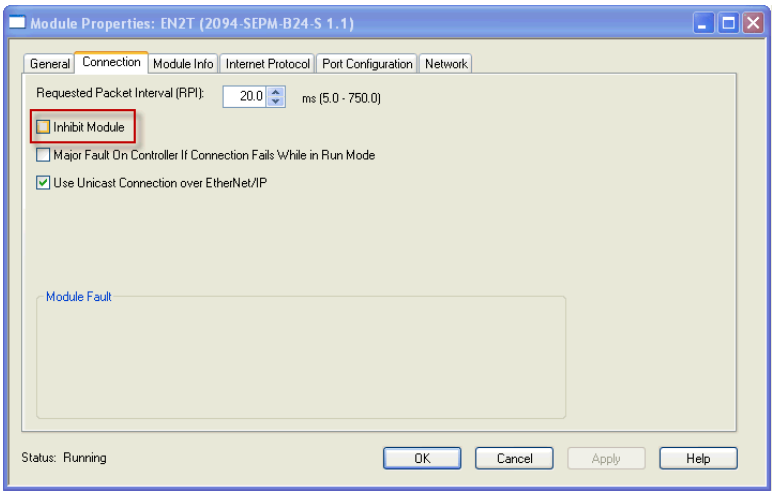
9. Click Close.
10. Minimize the RSLinx application dialog box.

IPIM Module Firmware Upgrade

IMPORTANT The IPIM module **will not** accept a firmware upgrade request when it has an active CIP I/O connection.

An active CIP I/O connection exists when the IPIM module has been integrated into the I/O configuration tree in RSLogix 5000 software. The IPIM module only accepts a firmware upgrade request when the connection is inhibited. The connection can be inhibited from I/O Configuration>Enet Module>IPIM Module Properties>Connection tab (see below). The IPIM module always accepts a firmware upgrade request if it is connected to a Logix Ethernet module, but has not been integrated in the I/O configuration tree.

Additionally, the firmware upgrade can be accomplished by disconnecting the IPIM module from the Logix Ethernet module and establishing a direct connection to a computer with ControlFlash software.



Follow these steps to select the IPIM module to upgrade.

1. Make sure the IPIM module will accept a firmware request prior to attempting the firmware upgrade (see page 117).
2. Open your ControlFLASH software.

   You can access the ControlFLASH software by either of these methods:

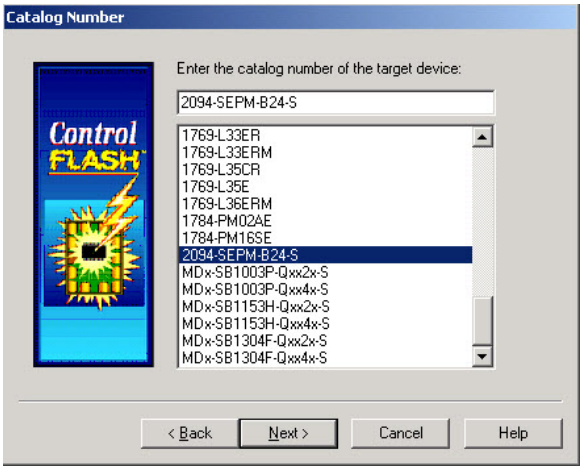
   - From the Tools menu in RSLogix 5000 software, choose ControlFLASH.
   - Choose Start>Programs>FLASH Programming Tools> ControlFLASH.

   The Welcome to ControlFLASH dialog box opens.

Welcome to ControlFLASH
Welcome to ControlFLASH, the firmware update tool. ControlFLASH needs the following information from you before it can begin updating a device.
1. The Catalog Number of the target device.
2. The Network Configuration parameters (optional).
3. The Network Path to the target device.
4. The Firmware Revision for this update.
View Log
< Back
Next >
Cancel
Help

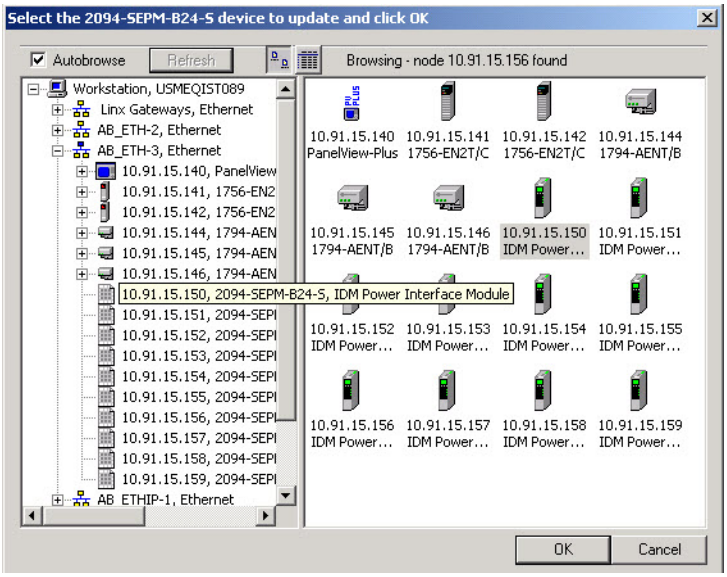
3. Click Next.

   The Catalog Number dialog box opens.



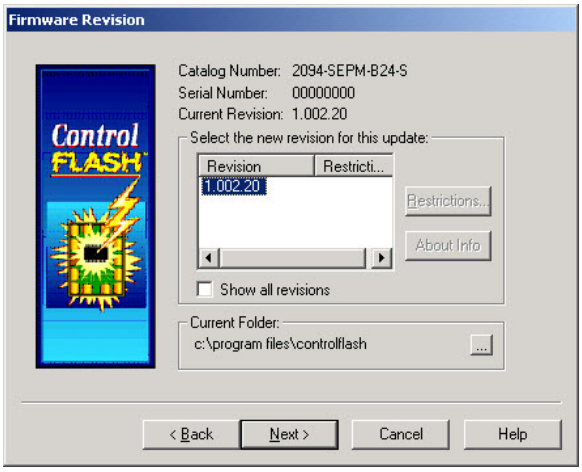
4. Select your IPIM module.
5. Click Next.

The Select Device to Update dialog box opens.



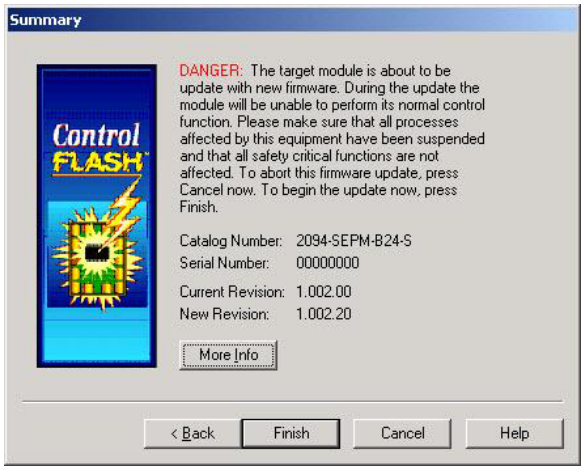
6. Expand your Ethernet node and EtherNet/IP network module.
7. Select the IPIM module to upgrade.
8. Click OK.

   The Firmware Revision dialog box opens.



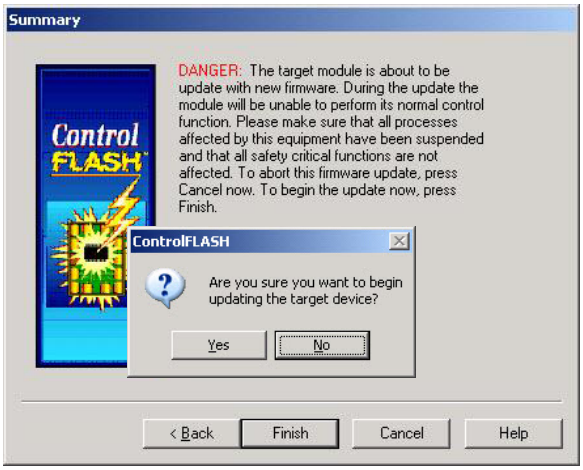
9. Select the firmware revision to upgrade.
10. Click Next.

The Summary dialog box opens.


Summary
Control FLASH
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all safety critical functions are not affected. To abort this firmware update, press Cancel now. To begin the update now, press Finish.
Catalog Number: 2094-SEPM-B24-S
Serial Number: 00000000
Current Revision: 1.002.00
New Revision: 1.002.20
More Info
< Back
Finish
Cancel
Help

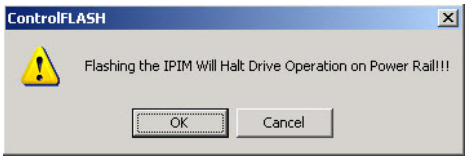
11. Confirm the IPIM module catalog number and firmware revision.
12. Click Finish.

    This ControlFLASH warning dialog box opens.


Summary
Control FLASH
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all safety critical functions are not affected. To abort this firmware update, press Cancel now. To begin the update now, press Finish.
ControlFLASH
Are you sure you want to begin updating the target device?
Yes
No
< Back
Finish
Cancel
Help

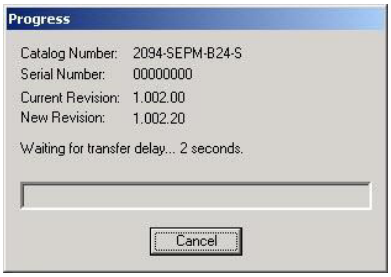
13. Click Yes (only if you are ready).

    This ControlFLASH warning dialog box opens.

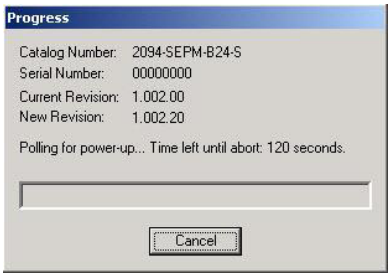


14. Acknowledge the warning and click OK.

The Progress dialog box opens and upgrading begins.



After the upgrade information is sent to the IPIM module, the module resets and performs diagnostic checking.



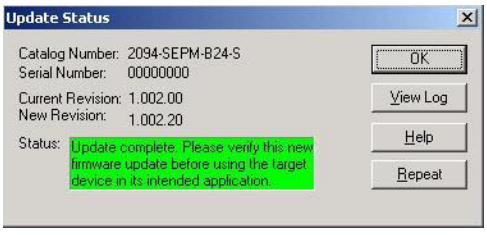
15. Wait for the Progress dialog box to time out.

    It is normal for this process to take several minutes.

IMPORTANT	Do not cycle power to the drive during this process or the firmware upgrade will not complete successfully.

16. The Update Status dialog box opens and indicates success or failure as described below

Upgrading Status	If
Success	1. Update complete appears in a GREEN Status dialog box. 2. Go to step 17.
Failure	1. Update failure appears in a RED Status dialog box. 2. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105, for troubleshooting information.



17. Click OK.

IDM Unit Firmware Upgrade

Follow these steps to select the IDM unit to upgrade.

1. Open your ControlFLASH software.

   You can access the ControlFLASH software by either of these methods:

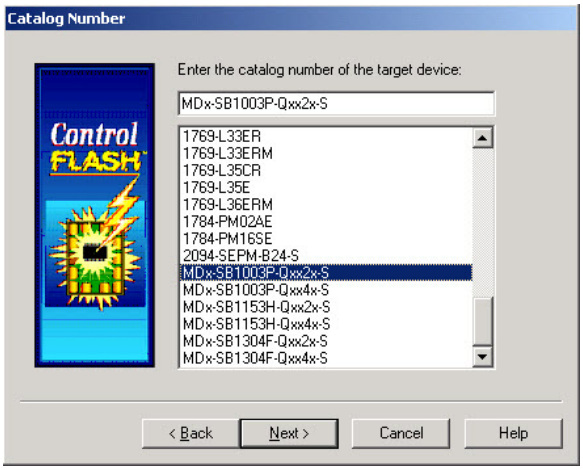
   - From the Tools menu in RSLogix 5000 software, choose ControlFLASH.
   - Choose Start>Programs>FLASH Programming Tools> ControlFLASH.

   The Welcome to ControlFLASH dialog box opens.

Welcome to ControlFLASH
Welcome to ControlFLASH, the firmware update tool. ControlFLASH needs the following information from you before it can begin updating a device.
1. The Catalog Number of the target device.
2. The Network Configuration parameters (optional).
3. The Network Path to the target device.
4. The Firmware Revision for this update.
View Log
< Back
Next >
Cancel
Help

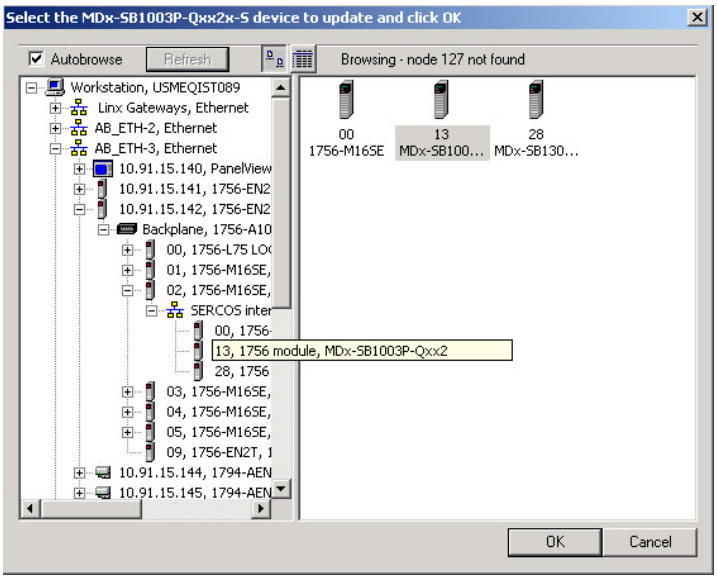
2. Click Next.

   The Catalog Number dialog box opens.



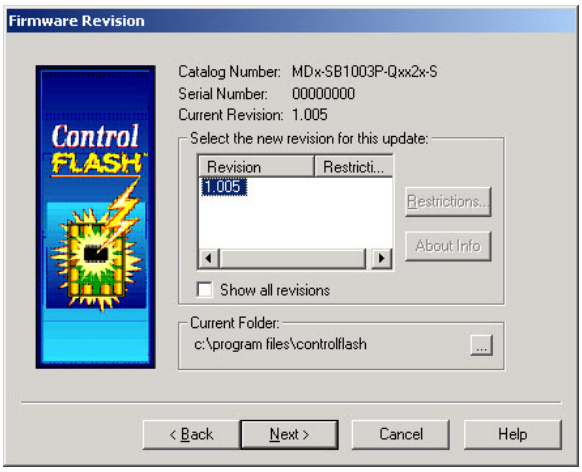
3. Select your IDM unit.
4. Click Next.

The Select Device to Update dialog box opens.



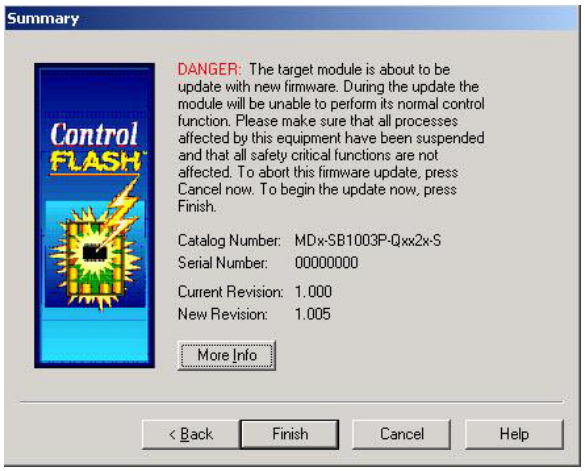
5. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
6. Select the IDM unit to upgrade.
7. Click OK.

   The Firmware Revision dialog box opens.



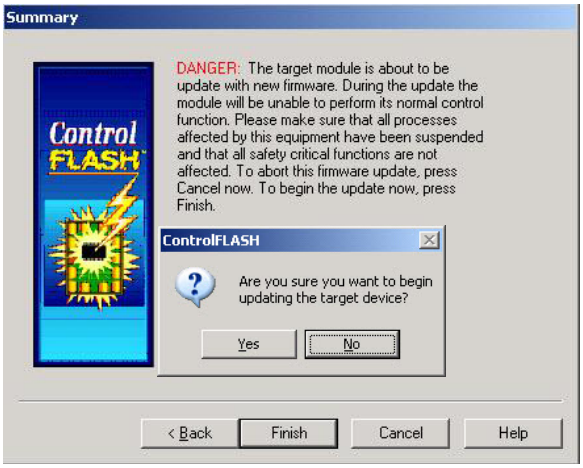
8. Select the firmware revision to upgrade.
9. Click Next.

The Summary dialog box opens.


Summary
Control FLASH
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all safety critical functions are not affected. To abort this firmware update, press Cancel now. To begin the update now, press Finish.
Catalog Number: MDx-SB1003P-Qxx2x-S
Serial Number: 00000000
Current Revision: 1.000
New Revision: 1.005
More Info
< Back
Finish
Cancel
Help

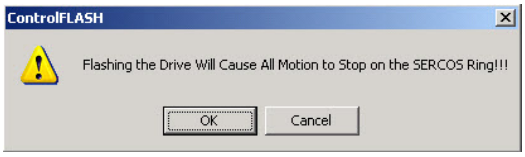
10. Confirm the IDM unit catalog number and firmware revision.
11. Click Finish.

    This ControlFLASH warning dialog box opens.


Summary
Control FLASH
DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all safety critical functions are not affected. To abort this firmware update, press Cancel now. To begin the update now, press Finish.
ControlFLASH
Are you sure you want to begin updating the target device?
Yes
No
< Back
Finish
Cancel
Help

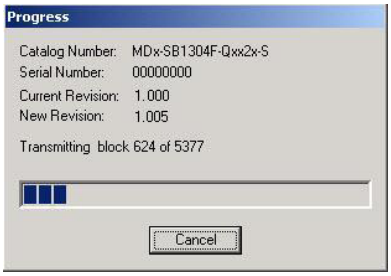
12. Click Yes (only if you are ready).

    This ControlFLASH warning dialog box opens.

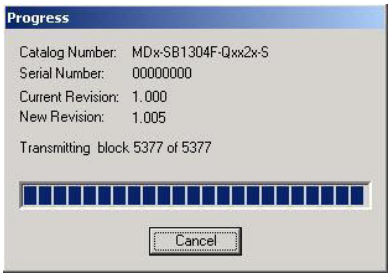


13. Acknowledge the warning and click OK.

The Progress dialog box opens and upgrading begins.



After the upgrade information is sent to the IDM unit, the unit resets and performs diagnostic checking.



14. Wait for the Progress dialog box to time out.

    It is normal for this process to take several minutes.

IMPORTANT	Do not cycle power to the drive during this process or the firmware upgrade will not complete successfully.

15. The Update Status dialog box opens and indicates success or failure as described below.

Upgrading Status	If
Success	1. Update complete appears in a GREEN Status dialog box. 2. Go to step 16.
Failure	1. Update failure appears in a RED Status dialog box. 2. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105, for troubleshooting information.

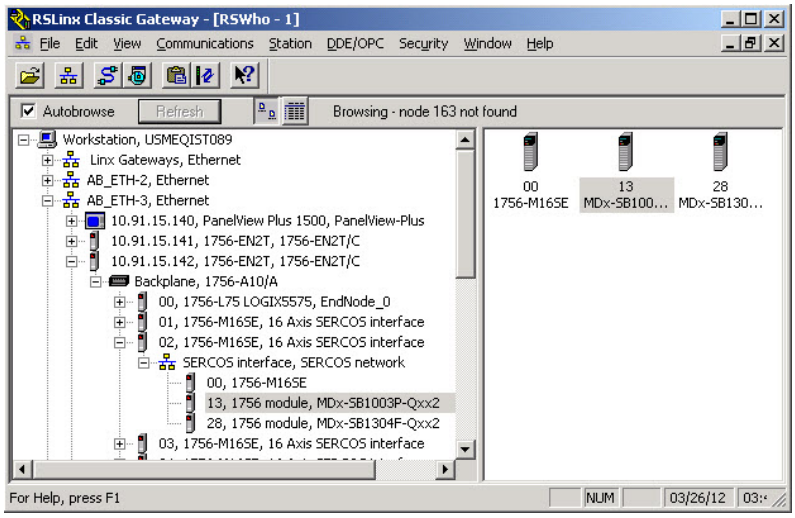
16. Click OK.

Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful. This procedure uses an IDM unit as an example, but applies to IPIM modules too.

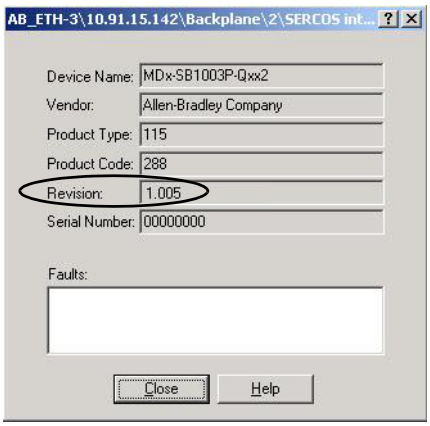
TIP Verifying the firmware upgrade is optional.

1. Open your RSLinx software.
2. From the Communications pull-down menu, choose RSWho.



3. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
4. Right-click the device (IPIM or IDM) and choose Device Properties.

   The Device Properties dialog box opens.



5. Verify the new firmware revision level.
6. Click Close.

Kinetix 6000M System Sizing

It is recommended that Motion Analyzer (version 6.000 or greater), be used for sizing your system. If manual calculation is desired, the following procedure can be used.

Topic	Page
Definitions	127
Manually Sizing the Kinetix 6000M System	128

Definitions

- Control power = 120/240 single-phase AC voltage connected to the IAM unit.
- IDM system control power = 42V DC (nominal) voltage from the IPIM module that is connected to all IDM units.
- IDM system control power load current = IDM unit control power current consumed by any single IDM unit.
- Total IDM system control power load current = Total IDM unit control power current consumed by all IDM units and connected to a single IPIM module.
- IPIM module control power load current = Total IDM unit control power load current (same as above).

Manually Sizing the Kinetix 6000M System

Step 1: Calculate the IDM unit control power load current for each IDM unit.

There are three components to the control power load current for each IDM unit:

- Constant power load
- Digital input loads
- Brake loads

Refer to the IDM unit constant load, brake load, and control power load specifications shown below.

IDM Unit Cat. No.	with Brake	Constant Control Power Load (W)	Brake Control Power Load (W)	Output Power Rating (kW)
MDF-SB1003	No	8	0	1.10
MDF-SB1003	Yes	8	15	1.02
MDF-SB1153	No	8	0	1.15
MDF-SB1153	Yes	8	19.5	1.00
MDF-SB1304	No	8	0	1.39
MDF-SB1304	Yes	8	19.5	1.24

The digital input load is calculated as follows:

$$\text{Digital Input Watts} = \Sigma I_{inputs} * V * \eta$$

Where:

ΣI_{inputs} = The sum of all load currents on the digital input power supply to power the sensor and/or the sensor input current

V = 24V

η = power supply efficiency = 80%

IMPORTANT Confirm that the total IDM unit control power load is less than the specified limit for the IPIM module output rating (270 W). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

IMPORTANT Confirm that the ΣI_{inputs} value is less than the specified limit (200 mA). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

Example

Example System:

- Common bus leader IAM module
- Two AM modules
- One IPIM module
- Six IDM units (shown below)
- 72 total meters of hybrid cable
- Control power = 120V AC, 60 Hz
- Main power = 480V AC => 675V DC

For this example, assume that each digital input uses 50 mA at 24V DC.

IDM Unit Cat. No.	Digital Inputs	with Brake	Constant Load (W)	Dig Input Load (W)	Brake Load (W)	Total Load (W)
MDF-SB1153	2	Yes	8	3.0	19.5	30.5
MDF-SB1003	0	No	8	0	0	8
MDF-SB1304	3	No	8	4.5	0	12.5
MDF-SB1304	0	Yes	8	0	19.5	27.5
MDF-SB1003	0	No	8	0	0	8
MDF-SB1153	2	No	8	3.0	0	11
					Total IDM Unit Control Power Load	97.5

The total IDM control power load is less than the specified limit for the IPIM so this is a valid system configuration.

Step 2: Estimate the IDM system control power load current for all IDM units connected to each IPIM module.

Estimating the load current for each IDM depends on the IDM control power voltage applied to each IDM. The loads calculated in step 1 are specified in watts, so the load current is estimated as:

$$I_i = \frac{W_i}{V_i}$$

$$I_L = \sum I_i$$

Where:

I_i = IDM unit control power load current for IDM i

W_i = load watts for IDM i

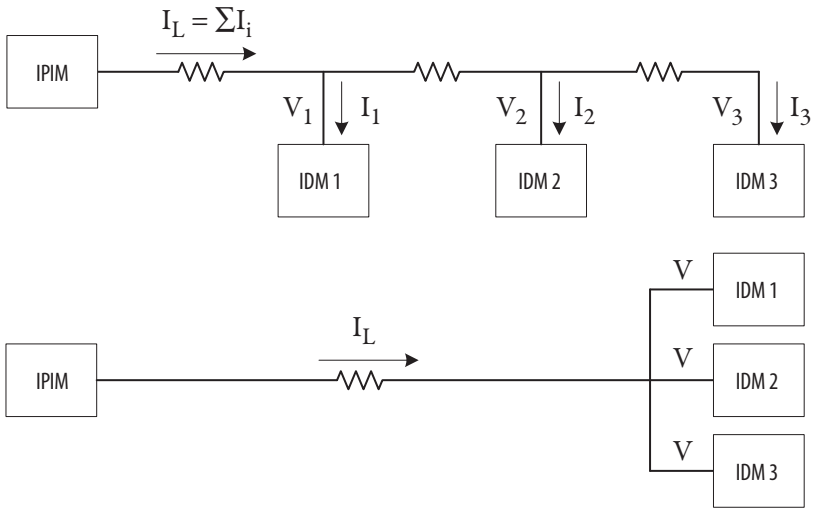
V_i = voltage applied to IDM i

I_L = Total IDM unit control power load current out of the IPIM

It is important to understand that each IDM unit passes the load current for all IDM units farther down the daisy chain. The voltage applied at each IDM unit is dependent on voltage drop in the IDM unit control power conductors of the hybrid cable. Therefore, the total cable length between an IDM unit and the IPIM module affect the voltage applied to that IDM unit. Also, the number of IDM units between an IDM unit and the IPIM module, and the cable length between each IDM unit also affects the voltage applied to the IDM unit. An accurate calculation requires modeling the system.

IMPORTANT Motion Analyzer version 6.000 or later contains a detailed model and accurately predicts the IDM unit control power load current and the minimum IDM unit control power voltage at the last IDM unit connected to each IDM unit.

This example illustrates a simplified load estimation method. The simplifying assumption is that all the IDM units are connected at the end of the hybrid cable so the entire cable length supports the total IDM unit control power current. This also means that the voltage applied at each IDM unit is the same and all IDM units experience the maximum voltage drop. The figure below illustrates a real system vs. the simplified system.



The specified voltage range for the IDM units is (32...44V DC). The IPIM module output voltage specification is (40.4...41.7V DC). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001. The equations below illustrate three options for estimating the IDM unit control power load current assuming a range of 32...42V DC using the simplified system. Steps 2 and 3 should be applied iteratively to get the best estimate, (see next step).

- Dividing the total IDM unit load power by 32V DC assumes that all the IDM units are at the end of the total cable length, and the load current is sufficiently high to result in the maximum allowable voltage drop at the end of the cable. This is a very conservative method that always results in an overestimate of the load current.

- Dividing the total IDM unit load power by 42V DC assumes that all the IDM units are at the IPIM module and experience no voltage drop from the hybrid cable. This is a very liberal method that always results in an underestimate of the load current.

- Dividing the total IDM unit load power by 37V DC represents more of an average situation where all the IDM units experience half the maximum voltage drop. This is a reasonable compromise between the other two extremes.

$$I_L = \frac{\sum W_i}{V_{32}} \qquad I_L = \frac{\sum W_i}{V_{37}} \qquad I_L = \frac{\sum W_i}{V_{42}}$$

IMPORTANT Confirm that the IDM control power current load is less than the specified limit for the IPIM module (6.5 A). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

Repeat this procedure for all IPIM modules connected to the power rail.

Example

Using the three equations from this step, the following IDM unit control power load currents are calculated.

IDM Unit Control Power Voltage Estimate (V DC)	IDM Unit Control Power Load Current (A)
32	3.05
37	2.64
42	2.32

The IDM unit control power current load is less than the specified limit for the IPIM module for all the load current estimates, so this is a valid system configuration.

Step 3: Confirm that all IDM units connected to each IPIM module will have sufficient control power voltage.

This is a complicated calculation to do accurately for the same reasons stated in step 2. The purpose of this step is to confirm that the last IDM unit in the daisy chain has sufficient voltage to operate. An estimate of the applied voltage assuming all the IDM units are at the end of the total cable length can be calculated as shown below. This calculation results in a very conservative estimate. It is conservative because it assumes the load current for all IDM units is carried by the total cable length, which overestimates the voltage drop on the cable significantly.

$$V_N = 42 - I_L * L_t * R_C$$

Where:

V_N = voltage at the last (*N*th) IDM unit (actually at all IDM units in the simplified system)

I_L = load current calculated in step 2

L_t = total hybrid cable length out to IDM unit *N* in meters

R_C = resistance of the hybrid cable control power conductors in ohms/meter (0.0274275)

IMPORTANT Confirm that V_N is greater than the minimum voltage specification for the IDM (32V DC). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

A better result may be obtained if step 2 and step 3 are repeated iteratively. The voltage determined for step 3 should be equal to the voltage value used in step 2. This gives the most accurate value for the simplified system.

Example

The equations in step 3 are applied to augment the table from the previous step (shown below). The estimate of the voltage assuming all IDM units are at the end of the total cable length is included in the last column.

Average IDM Unit Control Power Voltage Estimate (VDC)	IDM Unit Control Power Load Current (A)	Voltage Estimate at Last (all) IDM Unit(s)
32	3.05	36.0
37	2.64	36.8
42	2.32	37.4

This illustrates how the 32V average voltage estimate is a poor choice for this system configuration. Using 32V as the applied IDM unit voltage for the load current calculation results in a calculated voltage at end of the total cable length of 36V, so the 32V estimate is obviously too small. Using 37V as the applied IDM unit voltage for the load current calculation results in a calculated voltage at the end of the total cable length of 36.8V. Therefore 37V is close to the best possible value and a load current value of 2.64 A will be used for the remainder of this example. The total IDM unit load current as a percentage is 2.64/6.5 = 40.6%.

The voltage at the end of the total cable length is greater than the minimum voltage specification for the IDM unit, so this is a valid system configuration.

Using a more sophisticated model, the IDM unit control power load current was calculated to be 2.42 A and the voltage at the last IDM unit to be 40.15V. The total IDM unit control power usage was 103 W, compared to 97.5 W calculated in step 1. The additional 5.5 W are losses in the hybrid cable. This illustrates how using the simplified system for sizing overestimates the total IDM unit control power current and the voltage drop along the hybrid cable.

Table 24and Table 25 show the maximum cable length per IPIM module using Motion Analyzer.

The following is assumed:

- All IDM units are MDF-SB1304 (highest brake load).
- Cable length is identical between all IDM units.
- Minimum cable length is1 m (3.3 ft).
- Every other IDM unit includes a brake, starting with #2.
- When the number of brake IDM units are greater than 1/2 the total units, they are placed at the end of the daisy chain.

IMPORTANT When using the simplified system to calculate cable length, the resulting maximum cable lengths will be much shorter.

Table 24 - Max Cable Length per IPIM Module using Motion Analyzer (no digital inputs)

Number of Brake IDM Units	Number of IDM Units 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	25	50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
1	25	50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
2		50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
3			75	100	100	100	100	100	100	100	100	100	100	100	100	100
4				100	100	100	100	100	100	100	100	100	100	100	100	100
5					100	100	100	100	100	100	100	100	100	100	100	100
6						100	100	100	100	100	100	100	95	84	72	61
7							100	94	88	85	83	72	59	42	27	
8								92	77	60	44	30	13			

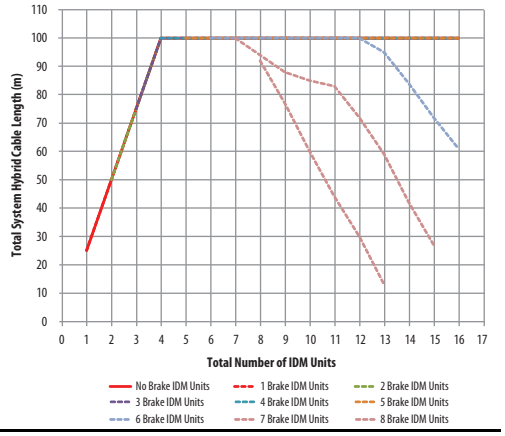
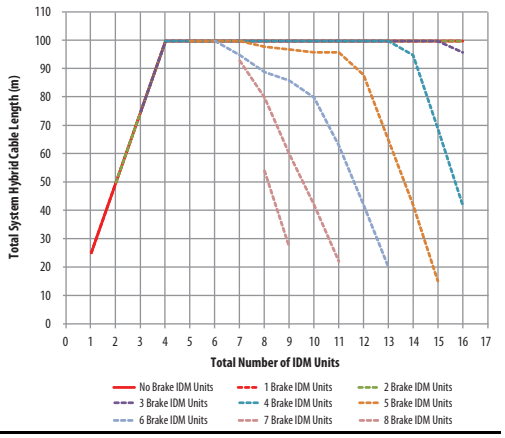

Total System Hybrid Cable Length (m)
Total Number of IDM Units
No Brake IDM Units
1 Brake IDM Units
2 Brake IDM Units
3 Brake IDM Units
4 Brake IDM Units
5 Brake IDM Units
6 Brake IDM Units
7 Brake IDM Units
8 Brake IDM Units

Table 25 - Max Cable Length per IPIM Module using Motion Analyzer (Digital Input Load = 50%)

Number of Brake IDM Units	Number of IDM Units 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	25	50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
1	25	50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
2		50	75	100	100	100	100	100	100	100	100	100	100	100	100	100
3			75	100	100	100	100	100	100	100	100	100	100	100	100	96
4				100	100	100	100	100	100	100	100	100	100	95	69	42
5					100	100	100	98	97	96	96	88	65	42	15	
6						100	95	89	86	80	63	42	20			
7							93	80	60	42	22					
8								54	27							


Total System Hybrid Cable Length (m)
Total Number of IDM Units
No Brake IDM Units
1 Brake IDM Units
2 Brake IDM Units
3 Brake IDM Units
4 Brake IDM Units
5 Brake IDM Units
6 Brake IDM Units
7 Brake IDM Units
8 Brake IDM Units

Step 4: Estimate the IAM control power load current and the power dissipation for each IPIM module based on the total IDM unit control power load.

See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001, for specifications on IPIM module dissipation and IPIM module control power loading. This information is also shown below. The table below contains equations that can be used to calculate the IAM control power load for each IPIM module and the heat dissipation for each IPIM module. The input value (x) is the total IDM unit control power load current (as a percentage) provided by the IPIM module. This value (in amps) was calculated in step 2. The value from step 2 must be divided by the rated IPIM module control power load current, (6.5 A).

IAM Control Power Interface	IAM Control Power Current (1)	IPIM Heat Dissipation (2)
120V AC, 50 Hz	$Y = 3.91x + 0.77$	$Y = 23.76x^2 + 20.73x + 16.54$
240V AC, 50 Hz	$Y = 2.39x + 0.60$	$Y = 18.56x^2 + 30.19x + 27.41$
120V AC, 60 Hz	$Y = 3.72x + 0.83$	$Y = 14.57x^2 + 11.40x + 20.01$
240V AC, 60 Hz	$Y = 2.45x + 0.61$	$Y = 19.63x^2 + 43.22x + 28.75$

(1) Y = IAM control power current; *x* = Total IDM unit control power load current percentage (value from step 2).
(2) Y = IPIM module heat dissipation from control power load; *x* = Total IDM unit control power load current percentage (value from step 2).

Make these calculations for all IPIM modules connected to the power rail. The control power load current values will be used to confirm the system sizing for the IAM, power rail and LIM in a later step.

Example

Using the equations provided, determine values for:

- Control power = 120V AC, 60 Hz
- IDM control power load current = 2.64 A or 40.6%

Result is an IAM control power load current of 2.32 A and an IPIM module heat dissipation value of 29 W.

Step 5: Sum the IAM control power load current for all devices on the power rail and confirm that the total IAM control power load current is less than the specified IAM and power rail limit.

- Calculate the total IAM control power load current by summing the load current calculated in step 4 for all IPIM modules.
- Use the "Control Power Current Requirements" table in the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001 or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, to select the control power current requirements for the IAM and any AMs on the power rail.
- Sum these two values for the total control power current requirement.

The control power load current calculated in step 5 must be less than the values in "Control Power Input Power Specifications" table in the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001 or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002.

Example

From the "Control Power Input Power Specifications" table in the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001 or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002, the total control power load current for the IAM and AMs is 2.25 A. The value calculated in the previous step for the IPIM is 2.32 A, resulting in a total control power load current of 4.57 A.

The control power load current is less than the maximum current specification for the IAM and power rail, 6.0 A, so this is a valid system configuration.

Step 6: Determine if a LIM can be used to supply the IAM control power load current, or if individual discrete components must be used.

In order to use a LIM for the control power interface to the IAM, the control power load current calculated in step 5 must be less than the values listed in the Line Interface Module (LIM) Installation Instructions, publication 2094-IN005. If control power load current exceeds the LIM rating, separate discrete components must be used for filtering, fusing and disconnection of control power. Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001 or the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002 for further information,

Step 7: Estimate the DC bus load current for each IPIM.

One method to estimate the DC bus load current is to analyze the motion profile of each IDM unit axis and estimate the RMS power per motion cycle. Motion Analyzer performs this analysis, and it can be challenging for complex motion profiles. Another option is to use the continuous output power specification for each IDM unit. Once an output power value is determined for each IDM unit, use the equation below to calculate a DC bus load current value for each IDM unit. This equation neglects the effect of voltage drop over the hybrid cable DC bus. However this affect is much less significant compared to the IDM control power voltage drop so ignoring it does not have a large impact on the estimation.

$$I_{bus} = \frac{P_{out}}{\eta * V_{bus}}$$

Where:

I_{bus} = IDM unit DC bus current load

P_{out} = IDM unit average shaft output power

η= efficiency, 80% (average)

V_{bus} = DC bus voltage at the IPIM nodule

Calculate the total bus current by summing the I_{bus} current values for all the IDM units connected to an IPIM module.

IMPORTANT The total bus current must be less than the maximum current specification for the IPIM module (24 A rms). See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001.

Example

The six IDM units in this example are listed below with the corresponding output power. The equation for bus current is used to calculate the bus current values for each IDM unit. The DC bus voltage is 675V DC. The DC bus current as a percentage of the IPIM module rating is 12.93 / 24 = 53.9%.

IDM Unit Cat. No.	with Brake	Output Power Rating (kW)	Estimated Bus Current (A rms)
MDF-SB1153	Yes	1.00	1.85
MDF-SB1003	No	1.10	2.04
MDF-SB1304	No	1.39	2.57
MDF-SB1304	Yes	1.24	2.30
MDF-SB1003	No	1.10	2.04
MDF-SB1153	No	1.15	2.13
		Total	12.93

The DC bus current is less than the continuous current specification for the IPIM module, so this is a valid system configuration.

Step 8: Estimate the IPIM module dissipation for the DC bus load current and the total IPIM module dissipation from the IDM unit control power and DC bus load current.

See the Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001 for specifications on IPIM module dissipation. This information is also shown in the equation below. This equation can be used to estimate the dissipation, in Watts, of the IPIM module as a function of the DC bus load current, expressed as a percentage of the maximum rating (24 A rms).

$$\text{Dissipation} = 33.95x^2 + 3.18x$$

Combine the dissipation value calculated from this equation with the dissipation from the total IDM system control power load current value from step 4. This is the total dissipation for the IPIM module.

Repeat for each IPIM module.

Example

The DC bus current was calculated as 12.93 A, or 53.9% of the IPIM rating. The dissipation for this DC bus current value is 11.7 W. The dissipation calculated for the total IDM control power (step 4) is 29 W. Therefore the total dissipation for the IPIM is 40.7 W.

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Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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